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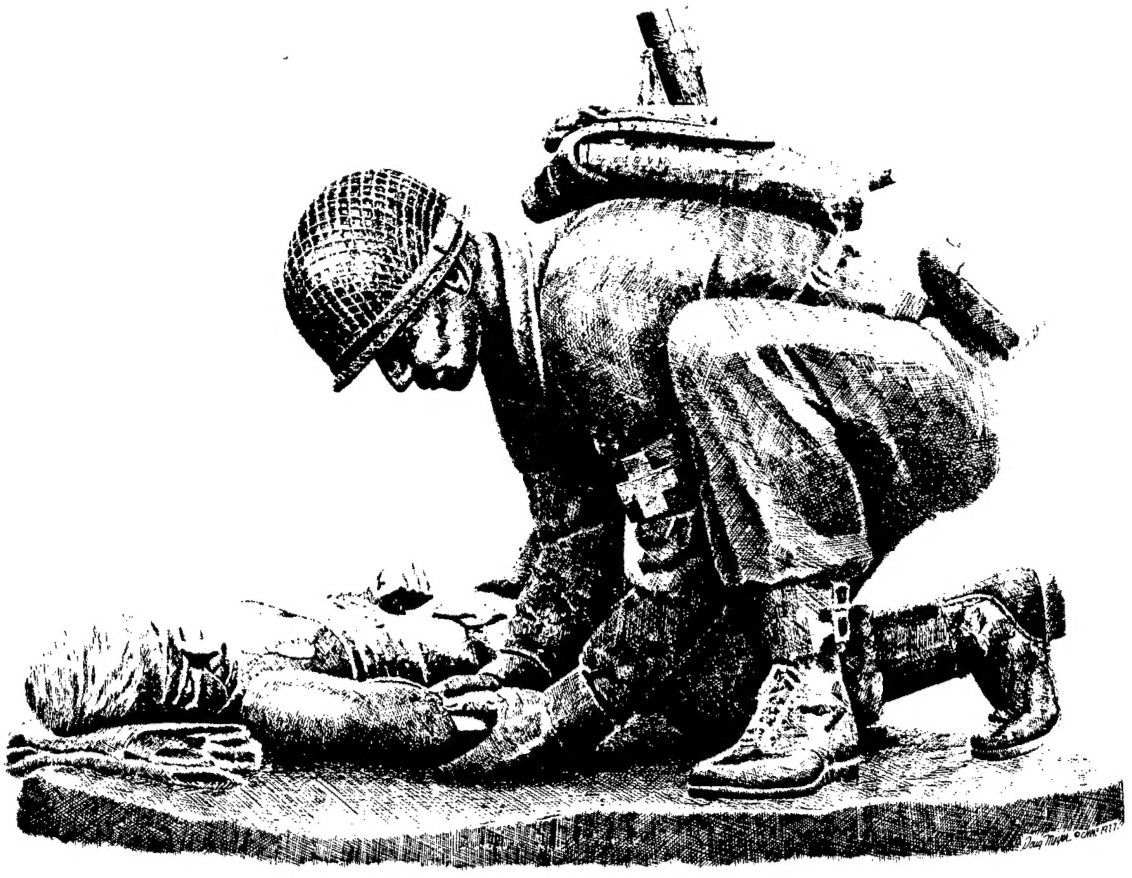

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Perspective

AMEDD at AMSUS

The Association of Military Surgeons of the United States (AMSUS) hosted its 105th Annual Meeting in San Antonio in November. The theme for this year's conference was "Healthy Forces, Healthy Communities, and Healthy People: Fitness for Global Readiness." The Army Medical Department (AMEDD) demonstrated strong support for this theme in a multiplicity of ways at the conference. The Army Surgeon General, LTG Blanck, along with our sister services' surgeons general, kicked off the meeting. Speakers from all around the AMEDD were featured. Topics included a smoking cessation update from the Center for Health Promotion and Preventive Medicine, an overview of Military Health Services Systems from the Dental Corps, and the report on a model for biological agent incapacitation by the Veterinary Command.

The AMEDD Center and School was actively represented at the conference through a series of displays and booths. Instructional departments including the physician assistant, physical therapy, occupational therapy, and nutrition care programs showcased their programs, their graduates, and the important work they do for our customers and patients. Additionally, the AMEDD Center and School exhibited the Expert Field Medical Badge and Combat Lifesaver programs, the Knowledge Management Network, and the research efforts of the U.S. Army-Baylor University Graduate Program in Physical Therapy. The AMEDD Journal also had a display that highlighted some of the important issues of the day.

This edition of the AMEDD Journal is dedicated to the principles espoused in this year's conference theme: Fitness for Global Readiness. The articles in this issue underscore the importance of medical readiness and highlight the AMEDD's constant focus "to conserve the fighting strength."

- *50 Years of Excellence in Military Medical Training.* Provides a look back on the successful training programs in lung diseases. The symposium traces its origin in the now-closed Fitzsimons Army Medical Center and has graduated to national recognition.

Major General James B. Peake

- *Health Information Privacy Laws: Some Proposals.* Focuses on the state of affairs in medical records privacy and looks to the future of privacy in an ever-changing society. Privacy is a closely held tenet in medical care and issues of confidentiality directly affect AMEDD patients, families, and our providers.

- *The Revolutionary Flying Ambulance of Napoleon's Surgeon.* Describes the history of Dominique-Jean Larrey and his efforts to establish the modern roots of battlefield care. In large measure, Larrey can be credited for introducing many of the concepts used by today's AMEDD to provide combat casualty care.

- *Dental Readiness in Reserve Component Troops from "Call Forward 97."* Upwards of 25% of soldiers examined in this study were found to have dental conditions warranting a delay of mobilization. This information should serve as a reminder of the importance of pre-deployment screening for all soldiers.

- *Guerrilla Warfare and Land Mine Casualties Remain Inseparable.* Describes some clinical aspects of land mine injuries. With U.S. Forces often deployed to areas with high land mine counts, it is critical for all in the AMEDD to be familiar with this mechanism of injury and its implications to sustaining a healthy force.

- *The Reinforced Tooth Pontic: An Esthetic Alternative.* Describes a dental technique for replacing an avulsed or lost front tooth.

My thanks to all these authors for sharing their contributions.

Health Information Privacy Laws: Some Proposals

MAJ William H. Millar†
Maj Barry W. Evans††

This article delineates proposals for reform of the laws on public health information privacy. The analysis of a literature review of the laws in the 50 states, the District of Columbia, and Puerto Rico that regulate the acquisition, storage, and use of public health data is the basis for reform proposals. Virtually all states provide some statutory protection for governmentally-maintained health data for public health information in general (49 states), communicable diseases (42 states), and sexually transmitted diseases (STDs) (43 states). State statutes permit disclosure of data for statistical purposes (42 states), contact tracing (39 states), epidemiological investigations (22 states), and subpoena or court order (14 states).[1] Review of state laws reveals significant problems that affect both the development of fair and effective public health information systems and the protection of privacy. The proposals provided offer a balance between the social good of collection of health data (recognizing its tremendous value to the health of the community) and the individual good of privacy protection (recognizing the value of respect for persons).

Introduction

One of the core functions of the public health system is the collection, storage, and use of information about the population's health.[2] Historically, public health surveillance focuses on identifying and controlling persons with communicable diseases.[3] In the United States (U.S.), mandatory reporting of diseases predates the founding of the republic. A Rhode Island statute of 1741 required tavern keepers to report to local authorities any patrons known to harbor contagious diseases.[4] One of the 20th century's greatest public health accomplishments, the eradication of smallpox, was based ultimately on the prompt identification of local outbreaks and the widespread vaccination of potentially exposed persons.[5]

Epidemiological investigations have rapidly identified health threats through case reports. For example: The Center for Disease Control (CDC) noted that shortly after case clusters of unusual pneumonia and rare cancers among gay men were reported in 1981, epidemiologists described the acquired immunodeficiency syndrome (AIDS), and determined that is was likely caused by a transmissible agent spread via the same routes as hepatitis B. [6,7] Similarly, in 1993, investigators rapidly mobilized to action following reports of clusters of deaths among otherwise healthy residents of the southwestern U.S. Within months, scientists identified a new strain of *Hantavirus*, described its mode of transmission, and developed a means of prevention.[8]

Public health agencies gather data on more than just communicable diseases. Health agencies now collect and analyze behavioral information regarding alcohol and other drug use, seat belt and bicycle helmet use, smoking, exercise, and sexual practices.[9] To assess environmental risks, health agencies also collect such data as pediatric blood lead levels, and the incidence of cancers, birth defects, and pulmonary diseases.

The public health system requires reliable in-

formation about communicable, behavioral, and environmental risks to reduce morbidity and excess mortality.

Automation of health data offers new opportunities and poses new problems for public health. Health officials (U.S Department of Health and Human Services [DHHS] and the General Accounting Office [GAO]) and medical organizations (Institute of Medicine [IOM]) urge electronic collection and use of data to promote public health.[10-12] The systematic acquisition of a broad range of personal health data in digital form, however, poses a trade-off in loss of privacy. Americans react apprehensively when personally identifiable data are accumulated about their lives.[13] Health information can reveal intimate aspects about an individual's or a family's life and may affect one's ability to hold a job, maintain custody of children, secure immigration status, or obtain access to insurance or public benefits. The ability of patients to control the dissemination of personal information is greatly reduced as greater quantities of information are collected and transmitted to an increasing number of users in remote locations.[14] Generally, electronic records are not qualitatively different from manual records. However, it is much easier to build a personal dossier using automated, online, and interconnected systems.[15] The Health Insurance Portability and Accountability Act of 1996 mandates that Congress adopt security legislation by 1999. Open and extensive debate is necessary to resolve the philosophical issues that surround confidentiality of an individual's medical information. Health plans should support high security thresholds and significant penalties for violations.[16]

To a certain extent, respecting privacy and promoting public health are consistent goals; public health campaigns often depend on the community's trust and cooperation. However, a basic tension exists between the need for information and the right to privacy. Realistically, significant levels of privacy cannot exist within the wide and complex web of health data collection. Thus, as a society, we face a difficult issue: What is the proper balance between health information collection and privacy protection, and how might we realize this balance?[17]

The Public Health Information Infrastructure

Developing a public health information infrastructure is integral to contemporary efforts to "reinvent" the public health system [18] The IOM defines the public health information infrastructure as the framework that supports the electronic collection, storage, use, and transmission of information supporting the essential functions of the public health system.[19]

The development of a public health information infrastructure is not a concept, but an evolving reality. National, regional, and statewide databases are fast becoming "vast reservoirs" of public health information.[20] Presently, a number of data systems contain comprehensive information about health status and population-based research.[21] Data banks exist for specific kinds of data (genetic databases), diseases (AIDS, tuberculosis (TB), and cancer), and specific functions (childhood immunization).[22-25] The U.S. Public Health Service (PHS) maintains extensive databases on the health status of various populations.[26] The U.S. PHS also funds the development of automated systems linking state and local databases to nationwide networks.[27]

Surveillance, public health investigation, and epidemiological research are essential to the work of the public health. These activities include: testing and screening for disease; reporting names of persons with certain diseases to state and local health departments; notifying sexual partners and other contacts; and surveying disease prevalence or risk behaviors in certain populations. In short, surveillance enables the public health system to identify health problems, inform the public, intervene, and influence funding decisions.

Balancing Individual Rights with Public Needs

From the time of the earliest surveillance systems, citizens, often with support from the medical profession, have objected to governmental acquisition of health status information on the grounds of privacy.[28] Many forms of surveillance, most notably reporting, require physicians, allied healthcare professionals, and laboratories to disclose patient information to health departments. This raises several concerns. First, patients, often physically and mentally vulnerable, divulge intimate details of their lives to their physicians; medicine's paternalistic traditions have long recognized that the patient's "weakened position" compels strict confidentiality. Second, both law and ethics in the latter 20th century emphasize patient autonomy, which encompasses the right to privacy, and by extension, the right to control the dissemination of personal health information.[29] Third, confidentiality is central to a trusting physician-patient relationship; physicians implicitly or explicitly pledge to guard patient secrets. Fourth, respecting patient confidences promotes patient candor about health and disease risks. Failure to respect informational privacy could lead to decreased disclosures, less candid revelations, or reluctance to seek care.[30] Lastly, unauthorized disclosure of information could result in embarrassment or discrimination.

Health departments have a solid history of maintaining the confidentiality of personal information.[31] Disclosure to health departments (as opposed to family, friends, employers, or insurers) seldom results in any tangible harm such as embarrassment, loss of employment, or denial of insurance. However, patients may feel wronged simply because the government, without patient consent, maintains automated databases containing intimate and identifiable health information.

Respect for the individual is the primary basis of justifications for privacy. In contrast, justifications for collecting and using health information are based mainly on attaining societal or collective goods. In *Tarasoff v Regents of University of California, 1976*, the principle that "the individual protective privilege ends where the public peril begins" supports this aspect of the public health mission.[32] Ethical values weigh in favor of the rapid development of a health information infrastructure because it promotes effective public health interventions. However, health information alone cannot ensure a community's health, but it certainly contributes.

Public Health Information Privacy

Gostin et al, collected and analyzed laws relating to health information in 50 states, the District of Columbia, and Puerto Rico.[33] In consultation with the CDC and Council of State and Territorial Epidemiologists, they developed and distributed to epidemiologists a questionnaire and copies of the respective state statutes. After they summarized and analyzed the law in each state and territory, epidemiologists verified the accuracy in consultation with their respective attorneys general.

The GAO defines public health information as all health-related data collected and maintained by a governmental agency.[34] These data are distinguishable from personal healthcare information; they are not gathered principally for diagnostic or therapeutic purposes, rather for the aggregate good.

Analysis of Privacy Legislation. The survey of state legislation reveals significant problems that affect both the development of fair and effective public health information systems and the protection of privacy. While most states have nominal safeguards of public health privacy, they are often incomplete or inadequate.[35] Many state statutes are noncommittal about the degree of privacy protection afforded, accord weaker privacy protection to certain types of information, or grant health officials broad and unreviewable discretion to disseminate personal information.

Several specific privacy problems arise in the

legislation. First, statutes seldom specify a narrow group of individuals who are entitled to access and explain why they have a need for the information. Rather, the statutes may provide wide definitions of who may have access. Conversely, legislation may authorize access to so many groups that it undermines the right to privacy. Second, statutes are often noncommittal about secondary uses of information (disclosure of data for purposes beyond those used to justify the original collection).[36] Predictably, subjects of the data are uncertain about whether, or to what extent, data collected for one purpose may be used for an unrelated purpose. Third, statutes often do not explicitly protect public health data from disclosure through subpoena or court order. This may render sensitive data vulnerable to disclosure in civil or criminal proceedings when required by the court.[37] Even when data are disclosed without legal authorization, penalties may be weak or nonexistent, or public health officials may be exempt from liability for their negligent handling of information.

In contrast to weak or erratic privacy protections, some states restrict information access to the point of impeding public health efforts and responses. Some states, for example, do not expressly permit disclosure to other state and local health departments for the control of communicable diseases.[38] Consequently, people with human immunodeficiency virus (HIV) infection, STDs, or TB may be lost when they move from state to state or to different programs within the same state due to difficulty in releasing patient-identifying information.

Independent evolution of state law produces considerable variation and inconsistency. Variability is often strength in a federal system of government, allowing state experimentation with complex issues. Variability in surveillance and privacy protection, however, creates problems in an increasingly mobile society in which disease outbreaks may occur rapidly in several locations, requiring systematic and consistent collection of comparable data sets.[39] Data sent from state to state does not receive reliable privacy and security protection. Additionally, individuals relocating across state lines cannot expect continuity in privacy protections of publicly held information.

The survey reveals a range of stratified legislative schemes, with states according particular diseases special status. Many states have enacted disease-specific statutes or provided distinct provisions for different disease categories. Each statute may mandate distinct data collection and reporting procedures, separate security arrangements, discrete justifications for disclosures, and specific permissible secondary uses.[40] Additionally, some state laws fervently protect certain disease-specific data (HIV and AIDS), they may be noncommittal about guarding information on other conditions. Consequently, different parts of the same health record may receive varying degrees of protection. Such a system is apt to confuse public health personnel, healthcare professionals, and the public. Inconsistent protection of personal health information may lead individuals to misunderstand or distrust public health efforts. Additionally, disease-specific legislation may hinder public health efforts by generating separate policies, programs, and procedures for diseases that may share common behavioral risk factors.

Proposals for Law Reform

The proposals apply to personally identifiable data, which raise the most crucial privacy concerns; the inclusion of any uniquely identifiable characteristic, such as a name, Social Security Number, fingerprint, or genetic link, classifies data as identifiable. Even without a unique identifier, the data may provide sufficient evidence to make a connection to a specific person. For example, information about race, gender, age, and other personal characteristics may make it possible to identify a specific person.

The proposals do not apply to anonymous, unlinkable data because they pose minimal privacy concerns. Data that have all identifiers stripped are anonymous. Blinded epidemiologic research and statistical applications of aggregate data provide examples of anonymous research that provides substantial public health benefits with negligible effects on individual privacy.

Linkable data present an intermediate level of privacy concern. These data are not immediately identifiable but can be linked to a named person with the use of a highly confidential code.[41] Data remain linked to permit future disclosure of information deemed vital to the health or safety of the patient or others (for example, to inform the patient of an infectious disease or available treatment).

Data Protection Review. A systematic and continuous review of privacy and security is essential to ensure a fair and effective public health information infrastructure. An independent data protection commission at the federal or state level should be established to carefully review privacy/security protocols and practices, including an examination of data collection justifications, informed consent procedures, information for subjects, fair information practices, and disclosures and secondary uses data. The commission should comprise personnel with experience and expertise in the fields of healthcare and public health, privacy/security, and law/ethics, and should include community representatives. To ensure accountability and ongoing discussion of privacy, the commission should make public its decisions and reasoning.

Data Collection Justification. Acquisition of health information is not regarded as an inherent good. Yet, privacy statutes should require a clear justification for the collection of personally identifiable information by public health authorities. Statutory criteria for data collection include preventing a significant public health risk, providing a likely benefit to the subject of treatment or other services, and conducting surveillance necessary to monitor and ensure the health of populations.

Public health authorities have the burden of demonstrating that data collection is likely to achieve the stated goal (public health authorities may legitimately seek to identify individuals with communicable diseases or STDs through testing, partner notification, and reporting). Yet, if resources are not provided for counseling and education, and if the efficacious therapy does not exist or access to healthcare is not ensured, the purposes of prevention and therapy are not likely achieved.

Public health authorities must substantiate the need for named identifiers when collecting information. If they could achieve the public health goal, as well or better without named identifiers, the collection of nonidentifiable or aggregate data is preferable. These data collection principles recognize that governmental authority to acquire sensitive personal information ought to be justified by substantial public health goals that cannot be achieved by means that are less invasive of individual privacy.

Information for Subjects. Although the government authorizes or mandates the collection of identifiable health data in accordance with the previous principles, subjects are still entitled to basic information. Subjects are entitled to know the purposes for the data collection and how the information will be used, the length of time the data will be stored, the circumstances under which it will be eliminated, and the degree to which third parties may obtain access. Data should be acquired, stored, used, and transmitted consistent with the information provided to subjects.

Fair Information Practices. Fair information practices require that no secret data systems

should exist. Patients and subjects should have access to information about themselves with identifiers to other persons deleted and access to just procedures for correcting and amending their personal records. Personal data should be eliminated when no longer needed for the stated purpose, and public health officials should ensure the reliability of the data for their intended use and take rigorous precautions to prevent misuse of the data.[42]

Privacy and Security Assurances. Legally binding privacy and security assurances should be attached to personally identifiable public health information. The collector of public health information should be under a legal duty to maintain the confidentiality of that information and to store it in a secure system. Significant penalties should apply for breach of privacy or security assurances.

Privacy and security assurances under law should apply to all users of the information. Accordingly, when public health information is transmitted to a third party, the recipient should be required to honor the same privacy and security assurances as the record's original holder. The duty to protect data, then, would be transferred simultaneously with the data, as would liability for violation of privacy or security standards.

Disclosure of Data. Disclosure of public health data could be made only for purposes consistent with the original collection. Thus, data could be disclosed only when clearly necessary to avert a significant health risk, for the direct therapeutic benefit of the subject, or for surveillance. For example, information gathered to prevent a significant public health risk could be shared only with those officials or professionals essential to avert the risk. This limitation would not undermine public health goals, for the principle permits sharing information between programs and across systems.

Public health authorities must follow the least-intrusive-disclosure principle. Thus, the disclosure of information must be the narrowest in content, least identifiable and sensitive, and to the fewest number of people as reasonably necessary to achieve the stated purpose.

Secondary Uses of the Data. Secondary uses of data occur when information is used in ways that are incompatible with the original purposes of collection. Secondary use of identifiable information beyond those originally intended by the data collector should be permitted only with the informed consent of the subject. Thus, information collected for a permissible purpose such as prevention, treatment, or surveillance could not be used in other ways that might affect the person's rights, privileges, or benefits without the subject's authorization.[43] Secondary uses of data in aggregate or nonidentifiable form would be permitted without the patient's consent if there is a strong public interest.[44]

Conclusion

The proposals for law reform are subject to criticism both from privacy advocates, who believe virtually all data collection and disclosure must be severely limited and subject to rigorous informed consent requirements, and from public health providers and researchers, who believe any barrier to data collection and use impedes cost-effective public health activities. These proposals offer a balance between the social good of collection of health data (recognizing its tremendous value to the health of the community) and the individual good of privacy protection (recognizing the value of respect for persons). As a society, we confront some hard choices between acquisition, storage, and use of public health information and informational privacy. Which do we most value, to what extent, and how can we best realize our answers?

Perhaps what the public desires is not abso-

lute privacy, but reasonable assurances that when personal information is collected, authorities will treat the information with respect, store it in an orderly and secure manner, and disclose it only for important health purposes and in accordance with publicly accountable principles of fairness.

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Guerrilla Warfare and Land Mine Casualties Remain Inseparable

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In 1139, the Lateran Council banned the use of the crossbow against Christians. In 1929, the Kellogg-Briand Pact outlawed war. Unfortunately, war has continued but the use of the crossbow in warfare has dropped off appreciably. Today, international efforts are underway to ban land mines in future conflict. Despite these well-meaning efforts, mines will most probably remain a constant feature of combat, particularly insurgency. Mines are cheap, easy to manufacture, easy to deploy, and provide an effective counter to a modern, mechanized force. Guerrilla forces, which often operate outside the parameters and without the protection of international law, may find that the efficacy and low cost of mines outweighs their prohibition by international treaties–particularly if the guerrilla force does not represent the state and is not signatory to the treaty. Modern plastic mines may be harder to purchase in the future, but some form of mine will still benefit the guerrilla.

Countering mines increases the logistics burden on a force, from the simple need to deploy the needed mine-clearing equipment and personnel, to the added medical and mortuary services. Mines that wound rather than kill are more effective since every wounded mine casualty ties up many support and medical personnel. Further, mines rob a modern mechanized force of its high-speed mobility and reduce the rate of ground movement to the speed of a cautious, dismounted sapper. The mere presence of mines has a marked psychological effect by introducing a further factor for reticence and caution on an already-dangerous battlefield. For these reasons, the problem of countering mines and treating mine casualties will almost certainly remain a constant for armed forces well into the next century. Just as soldiers need mine awareness training, military medical personnel need mine injury awareness training.

Mine Casualties and the Recent Past

The United States Army developed an expertise in treating mine casualties during the Vietnam War. Much of this knowledge is now almost 30 years old and most of the experienced medical personnel from that era are now out of the Army. Another modern force had more recent experience in treating mine casualties. Mine warfare played a major role in the Soviet-Afghan war of 1979 to 1989. The Soviet 40th Army used millions of mines in Afghanistan to protect their installations and deny the Mujahideen (their guerrilla foe) use of their lines of communication. The Mujahideen use of mines was far more limited and selective (and probably more effective tactically). Figure 1 shows Soviet 40th Army personnel deaths and vehicle losses to mines during their war in Afghanistan. As the graph shows, the Mujahideen did not have many mines at the start of the war, but soon obtained them. Soviet deaths due to mines were initially quite high until the Soviets developed mine countermeasures which cut their losses. These countermeasures included issuing flak jackets, sandbag-

ging and reinforcing vehicle floors, and riding on the tops of armored vehicles. Dissemination of these countermeasures was part of the in-country courses conducted by the 45th Separate Engineer Regiment.[1] After that, the number of deaths from mines fell, but the number wounded by mines rose. Vehicle losses peaked in 1984 and 1985 during the heaviest fighting in the war and fell off as the Soviets prepared to withdraw.

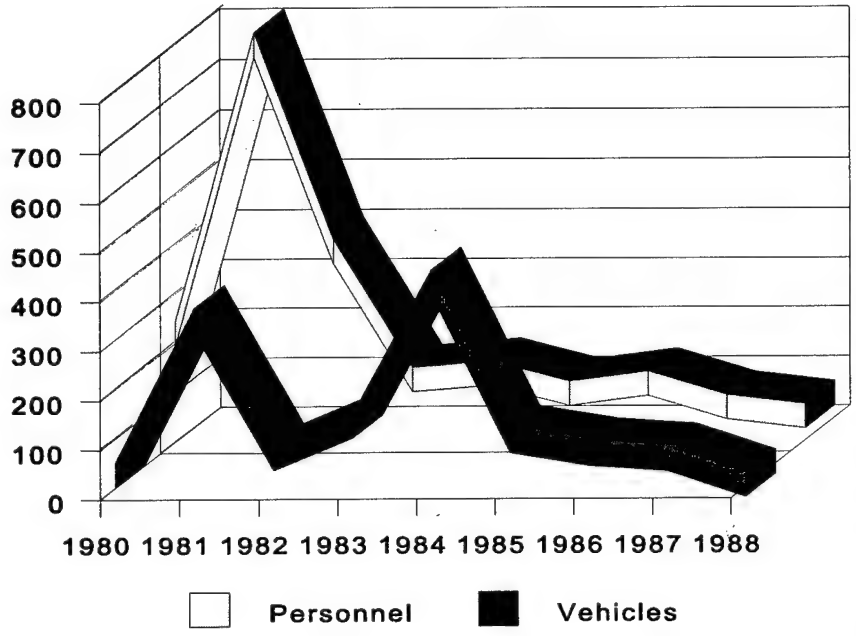

Fig 1. Soviet 40th Army losses to mines—personnel KIA and vehicles lost.[2]

Of the 620,000 Soviet personnel who served in Afghanistan, at least 14,453 were killed or died from wounds, accidents, or disease. This is 2.33% of those who served. A further 53,753 (or 8.67%) were wounded or injured.[3] In the early part of the war, there were twice as many Soviet soldiers wounded by bullets as shrapnel, but by the end of the war, there were 2.5 times more Soviet soldiers wounded by shrapnel than by bullets. The proportion of multiple and combination wounds increased four times over the course of the war while the number of serious and critical wounds increased two times. Land mines were the primary reason for this increase in serious and critical wounds. The number of wounded from land mines increased by 25% to 30% over the course of the war.[4] Improved Soviet medical evacuation during the war allowed more of the critically wounded to survive.[5] Throughout the course of the war, land mines caused 30% to 40% of the trauma cases treated by Soviet medical personnel.[6]

A Nasty Piece of Work

Mines can be antitank, antivehicular, or antipersonnel. Some destroy through the blast effect of the explosive charge while others rely on fragments driven by the explosive charge. They can be detonated by pressure, sound, trip-wire, or remote control. Some are buried in the ground, some bound out of the ground to explode at waist-level, and others are placed on or above the ground. Mines can kill or wound nearby personnel as well as those who directly trigger the mine. Mine wounds are primarily blast and shrapnel injuries that can attack any area of the body. For those personnel who step directly on a mine, the most common injury is the loss of a lower leg, with damage to the contra lateral leg.

The land mine casualty will probably go into shock (86.5% of Soviet mine-wounded did). In 10% to 15% of the patients, the shock, defined by tachycardia, hypotonia, and cardiac dysrhythmias, is so severe that it is irreversible even with standard resuscitation of fluids and support. Blood pressure may fall well below tolerated level and symptoms will appear to be out of proportion to the apparent physical causes. The patient will lose a great deal of blood (32.6% of Soviet mine casualties required 1 to 1 1/2 liters [two to three units], 53.1% required up to 2 liters [four to five units] and 14.3% required up to 3 1/2 liters [seven to eight units] of blood). Due to the drop in blood pressure, massive

forced infusion-transfusion therapy was necessary for these patients, but this often failed. Surgical intervention (such as amputations and surgical care of the wounds) within 2 or 3 hours of the infusion-transfusion therapy was poorly tolerated and frequently ended in death on the operating table.[7]

Electrocardiograms (ECGs) and clinical diagnosis show that heart injuries further complicate treatment of mine-injuries. The ECGs disclose myocardial ischemia and resultant dysrhythmias. Autopsies disclosed that 45.6% of the Soviet mine-wounded who died in hospital had suffered some form of heart injury. The heart injuries were macroscopically classified as focal, endocardial, and intramural hemorrhaging which ranged from a low blood flow to a higher blood flow from a damaged heart ventricle. Histological examination of the injured hearts revealed heart muscle fibers with no observable transverse striations and which were missing nuclei and had misshapen contours.[8]

Casualties with extensive lung injuries also experience profound traumatic shock. Their primary symptoms are labored breathing, cyanosis of the skin, shortness of breath, tachycardia, and a drop in blood pressure. These breathing problems, particularly if they are improperly treated, often result in death. Some 20% to 25% of Soviet mine casualties with injured lungs developed focal pneumonia within the first hours of injury consistent with adult respiratory distress. Soviet autopsies showed that 22.8% of mine casualties had lung injuries with large areas of blood-saturated tissue. Low-focal hemorrhaging was noted throughout the lungs.[9]

Land mine casualties will often suffer from a disturbance of the central nervous system (CNS). Patients who are particularly vulnerable to CNS disturbances are those who have not had proper intermediate care. The Soviet clinical picture showed that these patients would be brought into the hospital displaying the symptoms of pronounced traumatic shock. During the first hours, the patient would remain conscious and oriented in terms of time and space. Neurological examinations and a spinal tap would reveal no evidence of serious brain injury. Nevertheless, attempts to regulate the patient's hemodynamic indicators and breathing were generally not successful and the patients's brain functions would begin to worsen. The patient would lose consciousness or lapse into a deep coma. A significant portion of these patients would die from severe disturbances to the CNS. Autopsies would show an ischemic softening of brain tissue with hemo-saturation.[10]

The Soviets discovered that if infusion-transfusion therapy did not normalize hemodynamic indicators in land mine injuries, this was an indicator that the patient had suffered heart injury, serious brain injury, or was in early septic shock. The Soviet medical personnel learned to adjust their treatment accordingly.[11]

Heart injury required a longer pre-operative period than normal. The Soviet therapy involved cardiac glycocides, steroidal hormones, and non-narcotic analgesics. The Soviets would also administer antiplatlet aggregators and after-load reducers such as dipyridamole and antispasmodics. They normalized myocardial metabolism by preparations of potassium, cocarboxylase, adenosine triphosphate, and vitamins B/C). Once the Soviets stopped the bleeding, the infusion-transfusion therapy would switch to limited amounts of fluids–chiefly gluco-insulin mixtures and gluco-vitamin cocktails. They thoroughly filtered all blood used for transfusions, particularly preserved blood.[12]

Soviet experience with land mine casualties demonstrated that the usual time frames for surgical treatment of injuries did not apply. It was first essential to improve the contractile ability of the myocardium, eliminate any electrical instability of the heart, and normalize the hemodynamic indicators before surgery.[13]

Land mine wounds are very susceptible to septic shock resulting from extensive tissue damage and progressive wound infection. In severe

septic shock, it is very difficult to stabilize the hemodynamic indicators since the vascular channels do not respond to infusion therapy and the myocardium has a pronounced depression. Soviet intensive therapy for septic shock involved administration of cardiac glycocides, a large dose of steroids and enzyme inhibitors, antibiotics, low molecular and rheologically active infusion substances, and freshly heparinized blood. Once the hemodynamic indicators are stable, it was very important to prevent pulmonary edema by judicious use of diuretics.[14]

Soviet pre-operative procedures for land mine casualties with brain damage took 1 to 2 hours and involved dehydration therapy, paralysis, and ventilatory support.[15]

The Soviets learned that the killer was not the patient's loss of a limb to mine blast, but rather, shock and a combination of injuries to the internal organs once the bleeding was stopped. They also learned that normal treatment time periods may not apply and, although emergency surgery was often necessary, it was better to make sure that the patient was stabilized before doing any surgery. They discovered that performing multiple surgical procedures at the same time, though increasingly common under ideal circumstances, was not a good idea and should only be done by exception to save the patient's life. With land mine injuries, surgical procedures should be done sequentially, rather than simultaneously.[16]

The Mine and the Missing Leg

Russian military medical personnel have conducted extensive research on mine injuries based on a study of war dead and wounded, experiments involving dogs, and experiments involving biological dummies. Figure 2 illustrates some of their findings involving buried pressure-activated antipersonnel blast mines filled with 100 grams (3.5 ounces) of plastic explosive.[17]

This explosive power is sufficient to toss the victim some 30-50 centimeters (12 to 20 inches) off the ground. Zone Ia is an area of complete pulverization where all bones and other tissue are pulverized, vaporized, or blown off. At the mine face, the explosion produces from 200,000-300,000 kilograms per square centimeter (2,844,600-4,266,900 pounds per square inch) of pressure. No biologic element can withstand this. Zone Ib is an area of partial destruction of tissue and is normally marked by the end of the bone. Some bone fragments, pieces of skin and blood vessel, and nerve bundles that were not in the main blast path, may hang past the bone. Zone IIa is an area of shock-wave injury and trauma to tissue.

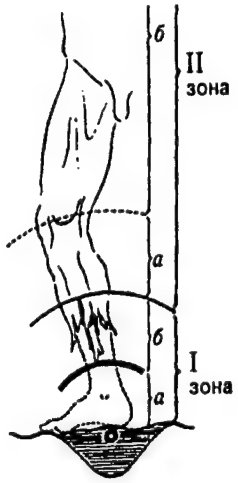

Fig 2. Zones of damage from antipersonnel mine.[18]

Zone IIb is an area of shock-wave contusion and concussion to organs and tissue.[19]

The degree of damage is a function of how far the foot was from the surface of the mine when it exploded–with direct contact being the most damaging. Zone I damage usually extends 15-20 times the radius of the mine surface.[20]

Zone IIa is the area of contusions and damage resulting from the blast and subsequent gases and dust pushing against the exposed bone and fascia. Here, the blood loss is concentrated along vessels

and nerve bundles. There is hemoinfiltration of the muscles which are attached to the bone and contiguous to the injuried vscular fissures. The upper boundary of Zone IIa is hard to define. It may be the area of contusion of the micro-capillary system of the bone with the line drawn at the closest vascular fissure. On the other hand, the boundary could be the upper segment where the damaged muscle is still attached to the bones.[21]

Zone IIb begins at thigh level if the extremity has been cut off at the shin. In the thigh, there are persistent disturbances to the tone of the major vessels and their pathways and branches. There is a decline in the capability of the vessels to circulate blood. There are compound disruptions of the micro-capillary system and muscle dystrophy in these sectors of the leg. These localized circulatory disruptions are generally reversible and repairable. Higher up the patients torso, trauma to the heart/lungs, CNS, and the brain are likely from antipersonnel mine blasts. The contusion-concussion syndrome affects these and other organs in the abdomen and chest cavity. The further the distance from the center of the blast, the less the extent of injury is a function of this distance alone. In other words, there is a physiological inequality among the various tissues and organs and they are susceptible to the effects of the blast wave to varying degrees. For the patient's survival, the treating physician must consider the comparative physiological importance of the various organs, as well as their biological and anatomical particularities.[22]

Contusion-concussion injuries are created by the blast wave traveling through and deforming the tissues. The effects of the deformation are cavitation, inertial resistance, and cleaving. The exfoliation and cleaving injuries are caused by the waves that advance along and through tissues. These tissues have varying acoustical rigidity, or firmness, which is manifested by phasic shift, wave reflection and wave absorption, or interference (see table below). The strength of the blast wave exceeds the elastic limits of the tissue and stratifies the affected tissues and tears the least-resistant tissues first. At a distance of 5-10 centimeters from the blast, the periosteum and surrounding muscles are pulled from the upper third of the tibia and fibula in an almost circular pattern (Figure 3).[23]

Indicator	Soft tissue	Bone
Density (grams/cm^3)	1-1.2	1.93-1.98
Displacement elasticity (dynes/cm^2)	$2.5x10^4$	$7.1x10^{10}$
Resistance to tearing (dynes/cm^2)	$5x10^6$-$5x10^7$	$9.75x10^8$
Tearing index [extent] (cm)	0.2-0.7	0.05
Acoustic impedance (dynes/cm^3)	$1.7x10^5$	$6x10^5$
Speed of sound (cm/second)	$1.5x10^5$-$1.6x10^5$	$3.36x10^5$

Physical Attributes of Human Tissue

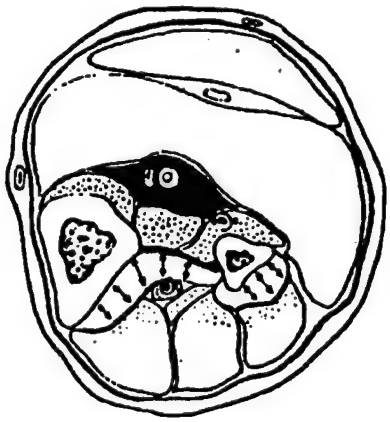

Fig 3. Periosteum and muscle pulled from the bone by land mine blast.[24]

The blood vessels develop multiple internal membrane fissures in the area 10-12 centimeters from the blast (Figure 4). Peripheral nerves are damaged and 30-40 minutes after the blast, the internal layers of the myelin sheath begin to fragment and twist into a spiral. The ultra-structural destruction of the nerve pathways progresses rather rapidly, with a retrograde periaxial peeling

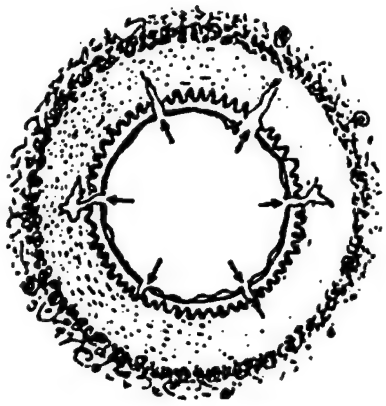

Fig 4. Radial fissures in the interior and middle membrane of an artery from a land mine blast.[25]

back of the myelin sheath over a period of 1 to 3 days. This demyelinization involves almost one-half of the branch nerve fibers of the sciatic nerve in the lower leg. One explanation for this phenomenon is that the cleaving damage is aided by the density of the myelin sheath which is three times greater than the surrounded neuroplasm in the axial cylinder (Figure 5).

Conclusions

Medical personnel should expect that mine warfare will continue to be a factor in future conflict, particularly counterinsurgency. The various efforts to ban land mines will likely make commercially produced land mines harder to obtain and locally manufactured land mines will take their place. These will normally be cruder, may contain more explosives, and may be more damaging. This would create greater problems for the

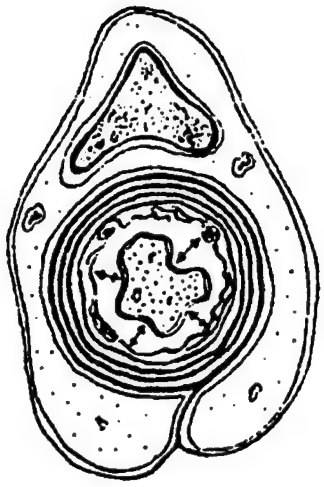

Fig 5. Demyelinization of nerve fiber from land mine blast.[26]

medical personnel, who are already challenged dealing with contemporary land mine casualties.

Peacetime land mine injury training will need to practice treatment of multiple external and internal injuries. Effective treatment will require responsive medical evacuation, early stabilization, and early admittance to a fully equipped hospital. Loss of a limb, extensive shrapnel injuries, shock, blood loss, respiratory difficulty, damage to multiple internal organs, sepsis, and a collapse of the CNS are common features of mine injuries. The Soviets learned that the patient killer was not the loss of a limb to mine blast, but the shock that follows. Once the bleeding was stopped, shock and various kinds and combinations of injuries to the internal organs were far more likely to result in death. The Soviets learned that normal treatment time periods may not apply and, although emergency surgery is sometimes necessary, it is better to make sure that the patient is stabilized before doing any surgery.

In future conflicts, forward-deployed medical teams will need to deal with these immediate problems while treating the patient, and rear echelon medical facilities will have to provide lengthy recovery, physical therapy programs, and prosthetics. Soviet experience is one source that U.S.

medical personnel can use to prepare for treating land mind casualties. As has often been observed, "Good judgement comes from experience and experience comes from poor judgement."

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9. Ibid.

10. Ibid.

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12. Ibid.

13. Ibid

14. Ibid

15. Ibid

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17. The 100 grams represents the U.S. M14 antipersonnel mine. It is one of the smallest antipersonnel mines and is called "the toe popper" by the troops. Soviet antipersonnel mines start at 200 grams. Most of the Soviet personnel mine casualties in Afghanistan were from the Soviet PDM mine—a small antipersonnel mine with 200 grams of plastic explosive.

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The Revolutionary Flying Ambulance of Napoleon's Surgeon

CPT Jose M. Ortiz†

Baron Dominique-Jean Larrey was Napoleon Bonaparte's respected surgeon and developed the most innovative and effective casualty transport system of his age. His "flying ambulances" not only saved countless lives during the Napoleonic Wars, but also served as a model for future armies well into this century.

Prior to the 18th century, the means used to transport the sick and the wounded, in both military and civilian life, were haphazard and unpredictable, where they existed at all. Even armies lacked the most rudimentary medical transport and services. Wounded soldiers might be left to die of hunger or thirst, if they did not succumb to their wounds, or their friends did not carry them to safety. Occasionally, some effort was made to tend the wounded, such as organizing the regimental band to perform this task.[1]

A revolution in the care and transport of military casualties began in 1792 when Dominique-Jean Larrey, MD, "invented and constructed the 'ambulance' or flying hospital, for the purpose of affording assistance to the wounded on the field of battle."[2] During the Napoleonic campaigns, Dr Larrey developed a system of casualty transport that served as a model for military medicine of his day as well as for future armies. This article will examine what influenced Larrey to develop such a system and trace the evolution of its design (particularly of the "ambulance") from its inception to its final production, use, and modifications.

First, it is necessary to provide some background on the state of casualty transportation prior to Larrey's system. Before the *flying ambulance,* there was very little organized transportation of the wounded from the battlefield. In fact, little had changed from the days preceding the use of firearms in battle. During earlier times, when swords and arrows created the majority of battlefield injuries, individuals usually took care of their own wounds. Sometimes, a doctor or barber would give additional aid to such injuries, but usually much later, well after the hostilities had ceased. However, with the advent of deadlier weapons utilizing gunpowder (and the rapid propulsion of more lethal projectiles), more serious wounds with greater amounts of devitalized tissue were produced. Such wounds were more susceptible to infection and required faster and more involved treatment by medical specialists. Thus, the old system of self-aid and inconsistent professional treatment *after* a battle, had proved to be grossly inadequate by the end of the 18th and the beginning of the 19th centuries.[3]

The term "ambulance" has evolved through the ages. Although wagons and carts have been recorded in history as means of transporting the sick as early as 900 A.D., the term "ambulance" was not used until its introduction by Queen Isabella of Spain in the 15th century; however, during that period it referred more to the military field hospitals and tents for the wounded rather than to the means of transporting wounded and dead from the fields of battle. Not until the time of Baron Larrey would "ambulance" take up its more current meaning of "a specially equipped motor vehicle, airplane, or ship for carrying sick or injured people, usually to a hospital."[4]

Dominique-Jean Larrey was born in July 1766

in Bordeaux, France to bourgeois parents. At the age of 14, he started his medical training, courtesy of his uncle, Alexis Larrey, a distinguished professor at the College of Surgery at Toulouse and Chief of Surgery at *l'hospital Saint-Joseph de la Grave*. Dominique enrolled at the *College de l'Esquille*, performing well academically, particularly in the field of anatomy. By the age of 21, he began his formal studies in surgery in Toulouse. During this time, Larrey was well-known to his professors and colleagues for his superior intelligence, maturity, and discipline. He later left Toulouse to further his medical studies and gain clinical experience in Paris. Larrey then went to Brest, in 1787, to serve on the Royal Frigate *Vigilante* for 7 months as the ship's doctor, traveling as far as Newfoundland.[5] During that voyage, he learned many important skills and ideas, especially about the crucial importance of hygiene and the treatment of various ailments. Larrey later returned to Paris to practice at *l'Hopital Royal des Invalides* and various other institutions. Working and teaching in Paris during some of the most turbulent years of the revolution gave him invaluable experience in treating battle-type wounds and injuries produced by the riots and fighting of that period. Larrey's good work was noticed, and he was appointed surgeon-major of the Army of the Rhine in 1792.[6]

According to his memoirs, Larrey first noticed serious disparities between the battle conditions of his day and the care and transport of casualties during the Campaign of the Rhine in 1792. During the sacking of the city of Spire, Larrey writes,

> "I now first discovered the inconveniences to which we were subjected in moving our ambulances or military hospitals. The military regulations required that they should always be one league distant from the Army.[7] The wounded were left on the field, until after the engagement, and were then collected at a convenient spot, to which the *ambulances* speeded as soon as possible; but the number of wagons interposed between them and the Army, and many other difficulties so retarded their progress that they never arrived in less than 24 or 36 hours, so that most of the wounded died for want of assistance...this suggested to me the idea of constructing an *ambulance* in such a manner that it might afford a ready conveyance for the wounded during battle. I was unable to carry my plans into execution until some time later."[8]

During this particular engagement, the advance guard was overpowered so suddenly that the distant French field hospitals had no chance of recovering the wounded. In contrast, Larrey was impressed by the sight of the wheeled French artillery's ability to quickly mobilize and escape from the hands of the advancing enemy.[9] This observation inspired Larrey to "propose to the general (Custine), and to the commissary general (Villemansy)...the plan of an ambulance, calculated to follow the advanced guard in the same manner as the flying artillery...called the *flying ambulance*."[10] After considering many designs (including one which carried wounded on litters strapped to horses), Larrey's practicality and experience favored the use of horse drawn carriages as central to the casualty transport system he would develop.[11] Such a simple, yet revolutionary idea, was the origin of today's meaning of the term "ambulance."

Larrey was eventually given the opportunity to implement his idea during an engagement near the Rhineland City of Limbourge. Larrey and his superiors were so impressed by the magnificent performance of his *flying ambulances* in this battle that Larrey himself was soon rushed to Paris to spread his system to other French armies.[12] However, other duties distracted him from completing such plans until 1797.[13]

Before proceeding, it is necessary to note that Larrey, while playing a crucial role in developing the first truly effective ambulance system, was not the first to recognize the fundamental problems in

casualty transportation of his time. In fact, in 1788, a royal *ordinance* was issued requiring the creation of better transportation for the battle wounded. On 12 November 1792, the National Convention declared the need to construct "suspended carts for the transportation of the sick and wounded of the armies."[14] By 1793, this issue increasingly became a political one, and a prize was offered in Paris for the transportation design which best fit a commission's specifications. Among these specifications was the requirement for the carriage to be "light, solid, suspended, and comfortable for carrying four or six casualties lying down, eight at most."[15] However, after 8 months of considering over 29 designs, the commission realized that its specifications were unrealistic. The political leaders at the time, nonetheless, insisted on developing a design by committee but only succeeded in producing an ambulance that was too heavy and impractical for the battlefield.[16] Such politically driven efforts only served to delay the widespread implementation of Larrey's more effective ambulance design, which had already been successfully field-tested.[17]

In May of 1797, Larrey was ordered by the Minister of War (at the request of Napoleon Bonaparte) to depart for Italy and aid in the medical affairs of the military campaign. Among his duties was to help establish military hospitals and to organize medical staffs of various French expeditions originating from Italy. While in Milan, Larrey was ordered by General Villeansky to develop a *flying ambulance* system.[18] Once again, Larrey implemented his ambulance designs into the French armies in Italy and developed training programs essential for the widespread use of his casualty transport system.

Larrey's system was composed of "a legion of 340, comprising officers, sub-officers, and privates." It was further broken down into three divisions of 113 men, with each division commanded by a chief surgeon. Each division had 12 light and four heavy carriages—each carriage manned by a crew of about seven men. Included in the chain of command of each division were:

> "One surgeon-major of the first class, commanding, with two surgeon's mates of the second class, 12 junior mates of the third class, two of them serving as apothecaries, a lieutenant, steward of division of *ambulance*, a sub-lieutenant, inspector of police acting as under steward, a quartermaster general of the first class of *ambulance*, two deputies of the third class of *ambulance*, a bearer of surgical instruments with a trumpet, 12 soldiers on horseback as overseers to take care of the wounded; among them a farrier, a saddler, and a bootmaker [*sic*], a commissioned sergeant major of the first class, two commissioned officers of the second class to precede the *ambulance,* three corporals retained for the performance of various errands, a lad with a drum carrying surgical dressings, and 25 foot soldiers as overseers to take care of the wounded."[19]

Obviously, Larrey spared few details in establishing and perfecting his casualty transport system. Everyone in his system had a specific duty and role to play. The ambulances were even organized to travel in a set order, and procedures were established for the management of the dead.[20]

In his memoirs, Larrey described the various uniforms of his medical staff. While such descriptions are not directly relevant to this paper, they do give us valuable information on the instruments and other resources carried into battle by his ambulances; such information also gives us more subtle insights on the daily work and challenges faced by Larrey's men. For example, the surgeons each "carried a small cartouch box...divided into several compartments, containing a case of portable surgical instruments, some medicines, and articles necessary for affording immediate assistance to the wounded, on the field of battle..."[21] In addition, officers were supplied with courier bags on their saddles, which contained field dressings instead of pistol holsters.

The 12 light carriages in a division had either two or four wheels, the former for use on level ground, and the latter for use in mountainous terrain. Larrey described his basic ambulance design as follows:

> The frame...resembled an elongated cube, curved on the top: it had two small windows on each side, a folding door opened before and behind. The floor of the body was moveable; and on it were placed a hair mattress, and a bolster of the same, covered with leather. This floor moved easily on the sides of the body by means of four small rollers; on the sides were four iron handles through which the sashes of the soldiers were passed, while putting the wounded on the sliding floor. These sashes served instead of litters for carrying the wounded; they were dressed on these floors when the weather did not permit them to be dressed on the ground.[22]

The only significant difference between the two and four wheel carriages, apart from the number of wheels, was mainly their size (especially their comparable height and length). Both, "were 32 inches wide, and were drawn by two horses." Their advantages, according to Larrey, were similar. They could both carry two patients lying at full length, and the window allowed for proper ventilation. There were compartments on the sides of the carriages for the storage of bottles, medicines, and other useful articles. In addition, various other tools, such as a handcart, could be attached to the carriage. Of course, the carriage design was not always initially suitable for all the missions and environments it faced and had to be periodically adapted to each situation at hand. For example, in rugged mountains, it had to be supplemented with mules for carrying supplies. Likewise, in the deserts of Egypt, camels were employed by Larrey to augment casualty transport. With such adaptations, Larrey took great pride in his basic ambulance design as "united solidly with lightness and elegance."[23] Apparently, Larrey was not the only one pleased with his *flying ambulances*, as he received much praise from Napoleon himself, as well as the commanding general at Padua.[24]

The larger ambulances "were drawn by four horses and had two drivers."[25] They also had a compartment in the back for carrying forage for the horses and were capable of carrying four men with their legs slightly folded.

In the following passage, Larrey succinctly expressed his observations of the practical advantages of his flying ambulances in combat:

> "With these ambulances, the most rapid movements of the advanced guard of an Army can be followed up, and when necessary, they can separate in a great many divisions, every officer of the medical staff being mounted, and having command of a carriage, a mounted observer, and every [*sic*] thing necessary for affording the earliest assistance on the field of battle."[26]

Furthermore, Larrey's ambulance also boosted the morale of the French troops since "they all felt confident that they would receive succor at whatever moment they might be wounded."[27] In sum, the ambulance system devised by Larrey proved to be both mobile and flexible enough to mirror the fluid battlefield of the Napoleonic age, while also providing rapid and competent medical care to the widest area possible.[28]

In his memoirs, Larrey is very explicit about the necessity of his *flying ambulances* in the the treatment of wounds requiring prompt amputation. He writes:

> "When a limb is carried away by a ball, by the burst of a grenade, or a bomb, the most prompt amputation is necessary. The least delay endangers the life of the wounded....I may even assert, that without the assistance of the flying ambulance...a great number would have died from this cause alone."[29]

While Larrey enjoyed the success of better amputation survival rates with the advent of his *flying ambulances*, the English were still suffering high mortality rates from similar wounds. When Larrey was given the opportunity to visit a British hospital in Egypt, he was surprised to discover that despite having excellent and clean medical facilities, the English had as little as three survivors out of a large group of amputees. In contrast, the French surgeons were enjoying much greater survival rates following similar operations. Whether or not the presence of the French *flying ambulances* and, hence, more immediate amputations, or the greater skill and more advanced medical doctrine of the French (the British were still performing delayed amputations during this period) were the critical factors at such disparities in mortality rates remains unclear. However, one can certainly extrapolate that Larrey's system of ambulance transportation, combined with his particular emphasis on performing amputations expediently, played significant roles in the superior success of the French doctors in such cases.[30]

Larrey noted the importance of early amputation of certain battle wounds as early as 1792. After observing several cases where fatalities occurred after amputations were either not performed or delayed (several days after sustaining a wound), Larrey developed his "24-hour principle." This established the standard to amputate a shattered limb within a day of its onset, if not "as soon as possible after the wound was incurred."[31] Such a principle likely was a great influence on the development of Baron Larrey's ambulance system as well as its rapid implementation by Napoleon.[32] Furthermore, this system allowed for greater success in more complicated operations such as multiple amputations. Wrote Larrey, "Before the erection of the *flying ambulance*...we seldom saw men who had lost both legs and arms: because the operation was delayed too long."[33]

Around the same time that Larrey was developing his *flying ambulance* system, another great French military physician, Baron F.P. Percy, was introducing a rival casualty transport system of his own. While comparisons between the ambulances of these two great men certainly favor Larrey's system, due credit must be given to Baron Percy for making the first improvements in casualty transport in the French Army. He was the first to introduce "a regularly trained corps of field litter-bearers, soldiers regularly formed and equipped for the duty of picking up the wounded...and carrying them on stretchers to the place where the means of surgical aid were provided."[34] The key differences between Percy's and Larrey's systems lay in their fundamental objectives. Percy's ambulance served mainly as a means of transporting surgeons and their instruments close to the engaged elements. In turn, stretcher-bearers could radiate from such proximity to retrieve the wounded. In contrast, Larrey's *flying ambulance*, a much lighter and swifter carriage, was designed to follow the advanced guard and provide initial treatment to the wounded (by applying dressings on the field of battle) while emphasizing the need to rapidly transport the more critically injured away from the battlefield. Wounded were, thus, evacuated to points in the rear where surgeons could more effectively perform lifesaving procedures.[35] Indeed, elements of both systems were harbingers of principles and procedures used even today in such fields as emergency medicine and in current military medical doctrine.

While including ink plates and rudimentary descriptions of Percy's ambulances in his memoirs, Larrey offered very few comparisons to his own ambulance design. He described Percy's ambulance as a "kind of *wurf,* the staff officers attached to it being on horseback, in the same manner as the flying artillerists; it also carries instruments and preparations for dressing."[36] When he wrote "wurf," Larrey probably meant the German word *wurtz* which refers to a "thick and short sausage...when combined with 'wagen' signifies a long wagon..."[37] Beyond such a simple description, Larrey made few, if any, references to Percy's ambulance system.

Percy also drew few comparisons between his

ambulance system to that of Larrey. He did, however, give a good account of the evolution of his system. In the fall of 1792, Percy, then the Consulting Surgeon of the French Army of the North, began to seriously consider improving battle casualty care and transportation. Certainly, he was partly motivated by the political pressures of his time. He also noted the delayed medical care administered to the wounded, particularly during retreats. His solution was to develop an ambulance that carried the surgeons and their instruments close to the battle. Furthermore, Percy's ambulance was light and quick enough to keep up with armies constantly on the move, both in advances and in withdrawals. In essence, Percy's ambulance was a mobile hospital which could carry as many as 10 persons (surgeons and assistants) with equipment, to critical points in a fluid battlefield.[38] The wounded were then brought to the surgeons, by foot, by a corps of stretcher-bearers. Such duty was not only quite strenuous and dangerous, but also was militarily significant: it relieved the common infantryman of the arduous task of caring for their own wounded.[39] While these were great innovations of this time, Percy's ambulance system never saw widespread battlefield implementation, and thus, never achieved the operational significance of Larrey's system.[40]

While there were few comparisons in the ambulance systems of Larrey and Percy in their own writings, other historians were less reserved in noting both the similarities and the key differences between them. The English historian, T. Longmore, noted that both systems had similar objectives. For example, they both created a specialized ambulance corps, which relieved the common foot soldier of the chores of caring for their wounded comrades. Furthermore, both systems created greater mobility for the physicians and their tools, although in slightly different ways. In Percy's system, the surgeon's tools were in the ambulance in which he traveled; Larrey's medical officers carried their instruments in the saddlebags of their mounts as well as in the accompanying ambulance. Finally, both systems sought to boost troop morale by the very nature of their effectiveness.[41] Writes Larrey, "Even the sight of these *ambulances*, which are always attached to the advanced guard, animates the soldiers and inspires them with the greatest courage."[42]

However, one major difference, according to Longmore, is in the vulnerability to enemy or friendly fire in battle. For example, since all the surgeons and major medical instruments of a unit were transported in one carriage in Percy's system, a loss of a single carriage could cause a major setback in the medical support on the battlefield. On the other hand, a disabled ambulance would be a relatively minor setback in Larrey's system, since only a single surgeon or minor pieces of the casualty transport system were lost. Furthermore, Larrey's ambulance was a much more rapid and efficient means of transporting wounded from the dangers of the battlefield compared to the stretcher-bearers employed by Percy. Larrey's system also had doctors, either on horseback or with the carriages, bringing only the most necessary instruments to the field. Their intent was to only perform stabilization and lifesaving procedures in the heat of battle so that the patient could rapidly be transferred to the rear for more definitive procedures. Thus, Larrey's *flying ambulances* had the advantage in safety, mobility, and flexibility and, as a result, were more effective and expedient in providing effective care to the wounded foot soldier than Percy's system.[43] The principle of rapidly transporting casualties from the perils of battle to locations where major surgery could be performed, as advocated by Larrey, was a harbinger of the medical evacuation systems later developed in Korea and Vietnam with helicopters.

The particular designs of the ambulances in these two systems were the basis of their relative efficacies. For example, Larrey's ambulance was lighter and smaller than Percy's and, thus, more maneuverable, faster, and better adaptable to rough terrain. On the other hand, the relatively heavier ambulance of Percy (as well as the philosophy of his system) inhibited it from rapidly pulling the

wounded from the battlefield as well as from effectively gathering its casualties and fleeing in the event of a rapid retreat.[44] One historian even suggested that Larrey's ambulance was more comfortable than Percy's.[45] In the end, history itself seems to be the final judge of these two systems, since it was eventually Larrey's that became the standard of medical evacuation for Napoleon's armies.[46] In contrast, Longmore's ambulance lived a rather ephemeral existence, which did not extend beyond supporting limited actions of the Army of the Rhine.[47]

The efficiency of Larrey's casualty transport system, as well as the adaptability of his ambulance, are demonstrated by their effectiveness in a wide variety of geographic locations and conditions. During Napoleon's victory in Aboukir, Egypt, in 1799, Larrey observed, "The wounded, after this affair, received the most prompt and effectual assistance from the surgeons of the ambulances and of the line; none were left more than a quarter of an hour without being dressed."[48] Larrey also supplemented his ambulances with camels, used as both pack animals and litter-bearers because of their particular adaptability to the desert environment.[49] Furthermore, Larrey's mobile ambulance's flexibility in design was proven time and again in its successes in even the most inclement of weather and in practically any geographic location: ranging from the mountains of Spain and the Steppes of Russia, to the hills of Poland and the deserts of Africa. His ambulance design was so well conceived and revolutionary that "while ambulance wagons were modified and adapted both for civilian and military use...few major changes were made for the next 100 years, until the motor ambulance came into common use in the early 1900s."[50]

In 1801, Larrey became The Surgeon General of the Imperial Guard, Napoleon's elite personal guard and shock reserve. It was with this unit that Larrey served in over 26 campaigns and earned the reputation as both a great field commander as well as physician. He was not only quite popular among the soldiers of the Imperial Guard, but was so esteemed by Napoleon that he was made a baron during his brilliant and distinguished service in the 1808 campaign in Spain.[51] Such was his fame and popularity that, as Napoleon's troops were fleeing Russia over the last bridge crossing the Berezina River in November of 1812, Baron Larrey was quickly recognized and specially lifted overhead by the crowd of troops, so that he could get safely across before them. While this paper focused mainly on Larrey's revolutionary advancements in casualty transport, one must not overlook the great strides he made in other areas. For example, he was the first surgeon to succeed in amputating a leg at the hip, made a multitude of innovations in the treatment of leg fractures, and was one of the most proficient physicians of his time at performing routine amputations.[52]

In multiple campaigns, Larrey commanded his ambulances with the control and coordination of the seasoned field commander that he was. For example, at Austerlitz in 1805, he skillfully posted and directed his ambulances such that the wounded "were almost all dressed on the field of battle."[53] Larrey attributed most of the effectiveness of his carriages in the heat of battle to their speed, allowing them to follow even difficult cavalry movements. Furthermore, their mobility allowed them to travel over most ground, particularly on roads either in great disrepair, or in poor weather conditions.[54] For example, during Napoleon's campaigns in Poland, where mud and rain bogged down much of the Army's movements, the *flying ambulances* were able to better overcome such challenging conditions than most other Army components. The flexibility of these ambulances also allowed many operations to be performed on the battlefield, with Larrey using them to travel anywhere his help was needed.[55]

The praise that Larrey and his corps of ambulances received was universal. Many private letters expressed great admiration of the courage and devotion of these men. They repeatedly risked their lives to save others, frequently under heavy fire

and in adverse circumstances.[56] Even enemy commanders held Larrey's efforts in great esteem and admiration. At the Battle of Waterloo, the Duke of Wellington even purposely directed his cannon fire away from Larrey's ambulances to give them time to collect their wounded.[57]

The development of an effective French combat casualty transport system during the Napoleonic Wars was essentially the result of one man's perceptiveness, initiative, humanity, and organizational skills (Larrey) combined with the strong support of a very talented battlefield commander (Napoleon). In many ways, the impact of Larrey's ambulances in decreasing combat mortality and morbidity in his day is comparable to that of helicopters in modern warfare. Unfortunately, subsequent armies did not always learn from such lessons, thus contributing to unnecessarily large fatalities in later conflicts in Crimea and in the United States. Future military doctors must take note and effectively study relevant military medical history. There is, undoubtedly, much to learn from such great men as Baron Dominique-Jean Larrey, who certainly earned the distinction of being called the "first modern military surgeon."[58]

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11. Barkley, p 18.

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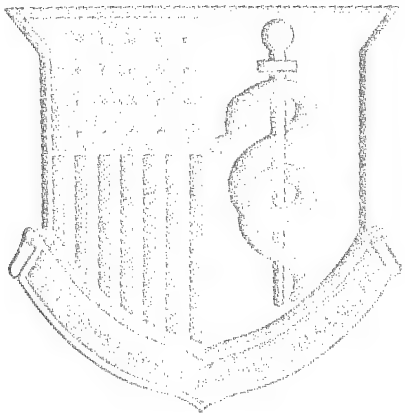


50 Years of Excellence in Military Medical Training

COL Thomas A. Dillard†

This year marks the 50th anniversary of the founding of the Carl W. Tempel Pulmonary Symposium. This article reviews the origins of the symposium and some of the contributions of its founder, Carl W. Tempel, to the Army Medical Department (AMEDD). In addition, this report provides an update on the current format and content of the symposium and summarizes topics of military relevance presented in that forum in recent years. The annual event continues to address issues of key importance to active duty soldiers and medical providers.

Introduction

The 1998 session of the Carl W. Tempel Pulmonary Symposium represents the 50th anniversary of the founding of this event. The symposium for this year will take place in Reston, Virginia, from 18 to 22 Nov 98. The occasion of the 50th anniversary provides an opportunity to recall the origins of the symposium and to appreciate its founder for his contributions to the AMEDD.

In the years since its founding, the Tempel Pulmonary Symposium has evolved into a scientific session of considerable importance to pulmonary disease specialists (60F) as well as critical care specialists (M4) in the AMEDD. The symposium typically places a major emphasis on medical readiness of active duty troops and on original research. As an indication of the continuing evolution of the symposium, this report identifies selected original research topics of military relevance that have been considered in recent symposia.

Origin

The symposium traces back to 1948 when COL arl W. Tempel, Chief of the Pulmonary Disease Service at Fitzsimons Army Hospital, in Aurora, CO, initiated a comprehensive lecture series on the care and management of patients with tuberculosis (TB) for healthcare providers, including new interns and residents. At that time, and for decades earlier in this century, Fitzsimons Army Hospital served as a TB sanitarium for the Army, treating many active duty patients. In the late 1940s, the era of pharmaceutical treatment of TB was gaining momentum.

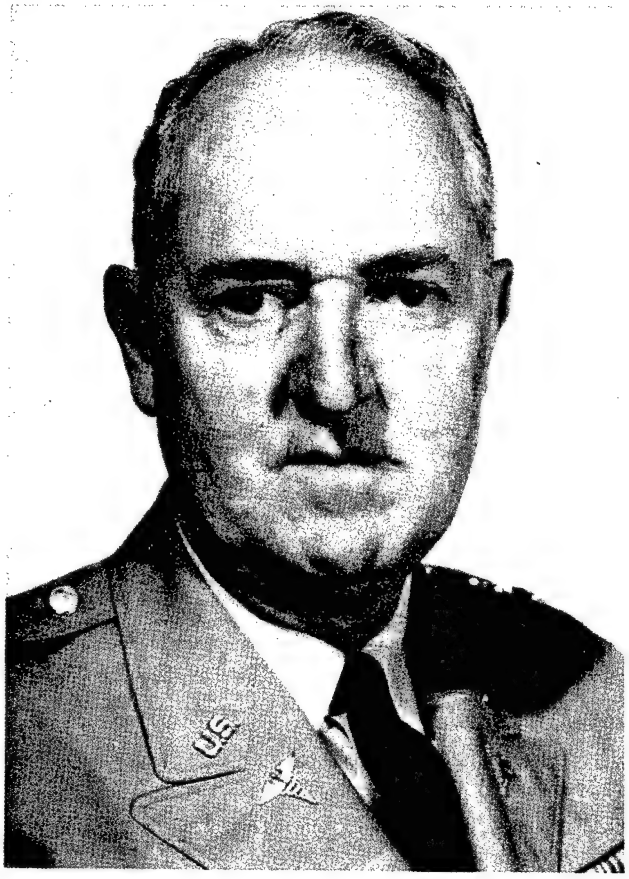
Through his efforts over a period of years, COL Tempel had a major impact on the medical management of TB. He went on to attain the rank of Major General (MG) and became Commanding General at Fitzsimons Army Hospital in 1961. After retiring from the Army, MG Tempel joined the Webb-Waring Institute for Medical Research at the University of Colorado Medical Center. According to a 1963 account by a fellow pulmonary physician, COL James A. Wier (who later became MG Wier), MG Tempel initiated the modern era of chemotherapy for TB in the Army, conducted large scale clinical trials, and founded methodology for follow-up and rehabilitation of active duty soldiers with TB.

Evolution

In the early years, the training program

founded by MG Tempel focused on the proper treatment of TB. Later, the scope of the meeting increased to include all aspects of diseases of the lungs and thorax. During the 1950s, participation increased to include co-sponsorship by the University of Colorado School of Medicine and the American Trudeau Society (which later became the American Thoracic Society), as well as attendance by military and civilian pulmonary physicians throughout the United States.

For over three decades, the meeting was known as the Annual Symposium on Pulmonary Diseases. The name was changed in 1980 to bear the name of Carl W. Tempel, in recognition of his efforts which initiated the annual event, as well as his contributions to clinical research and the treatment of pulmonary diseases in the Army. For a few years, the symposium was held concurrently with allergy/immunology subspecialty programs.



Major General Carl W. Tempel

After the Jan 84 meeting at Fitzsimons Army Hospital, the site of the Carl W. Tempel Pulmonary Symposium moved to San Francisco to run concurrently with the Present Concepts in Internal Medicine course sponsored by Letterman Army Medical Center and the American College of Physicians. Other specialties also joined the multispecialty program. With the closing of Letterman, both the annual meeting of the American College of Physicians for the U.S. Army Region and the Carl W. Tempel Pulmonary Symposium were held in Orlando, FL, for 1 year and then moved to their current location in Reston, VA, in 1994. For 1999, the symposium will be held in San Antonio, TX.

Status

The format of the Tempel Pulmonary Symposium has evolved over the years to place even greater emphasis on original research in the Army. The present symposium format functions as a scientific assembly for presentation and discussion of original work and collaboration on problems of mutual interest. The 1997 symposium included sessions with multiple speakers devoted to topics that included research in sleep medicine, vocal cord dyskinesia, acute respiratory distress syndrome (ARDS), asthma, and cardiopulmonary exercise testing. The format of the symposium promotes a dialogue among medical facilities concerning problem issues. The present format also includes joint sessions with multidisciplinary, critical care providers.

The content of the program has also varied over the years. While TB has declined in prevalence in active duty troops, other clinical problems that impair military readiness have emerged. These problems have been incorporated into the symposium, usually in the form of original clinical research presentations. The table shows a

Title	Author	Year
Methacholine challenge testing in ROTC cadets	Roth	1966
Hypersonic saline bronchoprovocation in asthmatics	Young	1997
Exercise testing in the evaluation of exertional dyspnea in active duty soldiers	Grbach	1997
Incidence of vocal cord dysfunction in military subjects with exertional dyspnea	Deal	1997
Successful treatment of upper airway resistance syndrome with an oral appliance	Cuneo	1997
Efficacy of upper airway surgery in sleep apnea	Worley	1996
Mandibular repositioning device in obstructive sleep apnea	Loube	1996
Accuracy of formulae estimating oxygen partial pressure during air transport	Dillard	1996
Masks for hypoxia inhalation challenges	Lawless	1996
Blast overpressure induced cardiopulmonary injury	Argyros	1996
Prone positioning in the ARDS	McCambridge	1997
Rapidly evolving ARDS with eosinophilia at an Army training center	Degler	1997

Selected Original Research Presentations at the 1996-1997 Carl W. Tempel Pulmonary Symposium

listing of selected original research topics of military relevance including asthma, sleep apnea, exercise testing, altitude hypoxia, air transport of casualties, and the ARDS. The content of the symposium serves as a mirror image of clinical research at U.S. Army medical treatment facilities.

Fifty years after its founding, the Carl W. Tempel Pulmonary Symposium continues to serve the needs of the AMEDD. The format and content have evolved to meet the changing needs of active duty forces and the medical community. The 1998 Carl W. Tempel Pulmonary Symposium will be held 18 to 22 Nov 98 at the Hyatt Regency Hotel in Reston, VA, in conjunction with the annual meeting of the American College of Physicians for the Army Region.

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RC Dental Readiness in Operation "Call Forward 97"

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COL Thomas Horning††

Introduction

Fort Drum, New York, provided the site for the mobilization exercise "Call Forward" during Aug 97. "Call Forward" is a Department of the Army exercise designed to evaluate an installation's ability to process Army National Guard (ARNG) and U.S. Army Reserve (USAR) units onto active duty. Processing Reserve Component (RC) soldiers to active duty is an essential mission of Fort Drum, and this exercise helped the Army measure the installation's ability to process soldiers following a presidential call-up. In addition, the exercise provided an opportunity to evaluate USAR soldiers' dental fitness.

Literature Review

Experience with prior reserve activations has led us to believe that the dental health of reserve soldiers is greatly inferior to that of active duty soldiers. The 1994 Tri-Service Comprehensive Oral Health Survey found that 12.6% of active duty soldiers were classified as a dental Class 3. The Department of Defense (DOD) Standardized Dental Classification System defines dental Class 3 as patients who have oral conditions that, if not treated, are expected to result in dental emergencies within 12 months.[1] The same survey found that 33% of Army recruits coming onto active duty had Class 3 dental conditions.

Fort Richardson, Alaska, hosted "Call Forward 95." Eight hundred twenty-eight reserve soldiers were dentally screened and 217 placed into dental Class 3. The Class 3 number correlates to 262 soldiers per 1000 who had dental conditions requiring correction prior to deployment.[2] King reported that during Operation Desert Shield/ Storm, over 150,000 ARNG and USAR soldiers were processed in the continental United States resulting in 33,000 soldiers, or 22%, requiring treatment to bring them to a deployable status.[3] A 1987 article by King and Tewles on the impact of dental health found that we can expect 67 dental emergencies per 1000 soldiers for those in Class 1, 145 dental emergencies per 1000 for Class 2 soldiers, and 530 emergencies per 1000 soldiers for those who are dental Class 3.[4]

Methods and Procedures

The Fort Drum Soldiers' Readiness Processing Center (SRPC) served as the site for this study. Soldiers were screened medically, dentally, and administratively in order to determine their deployability status and ability to perform their wartime mission. Members of the Fort Drum Dental Activity and reserve augmentees from the 7207th and 7237th Installation Medical Support units provided dental screenings at the SRPC site. Dental providers were briefed on the type of examination to be performed and a Clinical Standard Operating Procedure for Conducting Dental Readiness Checks During "Call Forward 97" were distributed. Soldiers' medical histories were updated and existing panographs verified to ensure that they were timely and of diagnostic quality. Those soldiers who required new panographs were sent to the dental clinic for the radiographs. A predeployment examination was performed with a mirror or tongue blade with the goal of identifying oral conditions most likely to cause a soldier to require emergency dental treatment and possible

evacuation out of a theater of operations. Only the specific dental disease that placed the soldier in a Class 3 status were annotated on the 603A form. Each soldier was then placed into the appropriate dental category following the screening examination.

Results

Thirteen reserve units and 1,450 soldiers processed through the dental station over two weekends. Three hundred ninety-nine soldiers were deemed to have a dental condition serious enough to classify them as a dental Class 3 (not recommended for deployment). The Class 3 number correlates to 275 soldiers per 1000, or 27.5%. Over 1000 teeth were identified as needing immediate treatment to bring soldiers to acceptable dental standards for deployment. Using this information, it was estimated that soldiers identified in "Call Forward 97" required 1300 treatment hours. The 1300 hours of treatment time only addressed Class 3 needs and not the time needed to bring these individuals into dental health, defined as dental fitness Class 1. A 1992 study by Amstutz found that 2.75 treatment hours were needed to bring a soldier from Class 3 to Class 2 and 8.65 treatment hours were needed to bring a soldier from Class 3 to Class 1.[5]

Findings from "Call Forward 95 and 97" on reserve soldiers as compared to active duty soldiers from the 1994 Tri-Service Comprehensive Oral Health Survey are illustrated in Table 1.

The dental treatment requirements of soldiers identified as being in dental fitness Class 3 from "Call Forward 97 and 95" are summarized in Table 2.

Grade	% of Class 3 Reservists (Call Forward 97)	% of Class 3 Active (Oral Health Survey[6])	% of Class 3 Reservists (Call Forward 95)
01-06	6.8%	4%	
E5-E9	29.3%	14%	
E1-E4	30.1%	13%	
Total	27.5%	12.5%	26.2%

Table 1.

Procedure Type	Teeth Requiring Treatment (Call Forward 97)	Procedures Per 1000 (Call Forward 97)	Teeth Requiring Treatment (Call Forward 95)	Procedures Per 1000 (Call Forward 95)
Operative	340	234	321	388
Endodontic	111	77	63	76
Oral Surgery	558	385	340	411
Periodontal	37	26	14	17

Table 2.

The classification of soldiers into their appropriate dental category (Class 1, 2, 3, or 4) has set parameters by regulation, but tends to be subjective between different practitioners. The tendency for certain conditions to be identified as dental Class 3 can vary from installation to installation, clinic to clinic, and among practitioners. The statistics of active duty dentists and reserve augmentee dentists regarding their placing soldiers in Class 3 were compared and no generalizations regarding classification tendencies can be made, as shown in Table 3 below and by percentages as shown in Figures 1 through 3 that follow.

	Active Duty Dentists			Reserve Dentists		
	Raw #	**Per 1000**	**% Procedures**	**Raw #**	**Per 1000**	**% Procedures**
Total Screening Exams	852		58.7%	598		41.2%
Total Class 3 Identified	175	205	45.3%	211	353	54.7%
Operative (No. of teeth)	186	218	35.6%	135	226	26.6%
Endodontic (No. of teeth)	58	68	11.1%	66	110	12.9%
Extractions (No. of teeth)	268	315	51.2%	292	488	57.5%
Periodontal (No. of teeth)	11	13	2.1%	15	25	2.9%

Table 3.

Discussion

The 13 units that participated in the exercise were merely a slice of reservists who are projected to be activated during the next major conflict. The results regarding dental Class 3 soldiers from "Call Forward 95 and 97" are very similar. The geographic difference did not affect the number of dental Class 3s. The results from these two exercises suggest that dental commanders can expect between 25% and 30% of activated reservists to have dental conditions needing treatment prior to deployment. If these conditions are not remedied prior to deployment, these soldiers may become noncombat dental emergencies. These potential dental emergencies will take the soldier away from his place of duty and hamper the unit's ability to complete its mission. In an era of reduced Army dental assets, a reserve mobilization with similar dental needs could quickly overwhelm the ability of local resources to provide dental care.

If the reserve units processed throughFort Drum were activated, there would be a potential of 275 dental emergencies per 1000 soldiers based on the number of dental Class 3s from the study. This number is significantly higher than previous studies of active duty soldiers. The demand for a readily deployable reserve force is paramount in light of recent drawdowns and future proposed rightsizings of the military. The RC plays a major role in the ability of the United States military to win two regional conflicts simultaneously. As in past exercises, the dental readiness of RC forces is

greatly inferior to active duty units. Seventy percent of dental emergencies are preventable, but historically account for 20% of disease and nonbattle injuries. These potential injuries will not only clog dental treatment capability and medical evacuation resources during wartime, but most importantly, leave commanders short of essential personnel prepared to complete their battlefield mission.

Conclusions and Recommendations

The dental health of reserve soldiers is greatly inferior to that of active duty soldiers and may impede or seriously impair mission performance, and possibly, mission completion during a conflict. An active dental classification surveillance system is present in the active duty population. This system gives units monthly reports on the dental status of their unit. To the author's knowledge, this system is, at best, passive in the RC. Suggestions to improve the dental readiness problem in the RC are numerous, with implementation being equally difficult. The newly implemented Tri-Care Selected Reserve Dental Program is a major step forward in ensuring the dental readiness and deployability of the RC. An active surveillance system would keep commanders routinely updated on the dental health of their command. The soldiers' chain of command must emphasize the ramifications of a reserve soldier being identified as a dental Class 3. Soldiers must not only be encouraged, but mandated, to correct their Class 3 situations in order to remain in the reserves. In

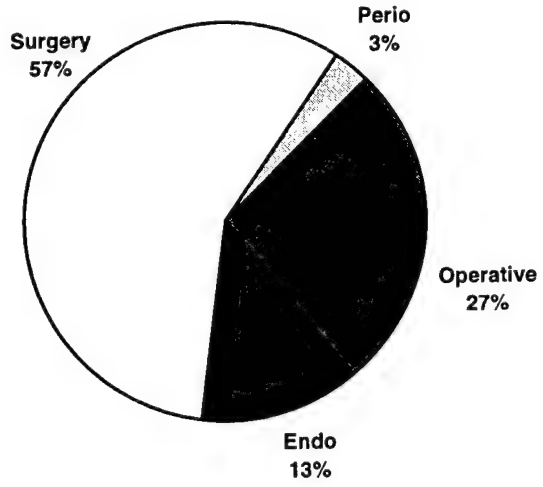

Fig 1. Percentage of soldiers classified Class 3 by reserve augmentee dentists.

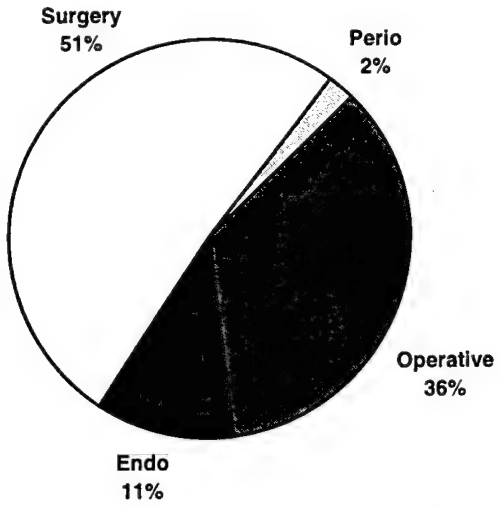

Fig 2. Percentage of soldiers classified Class 3 by active duty dentists.

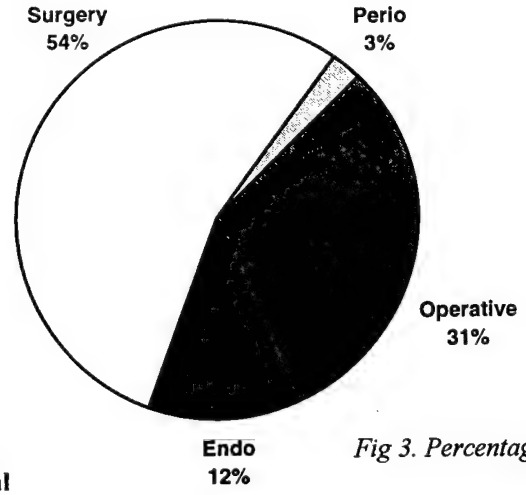

Fig 3. Percentage of total Class 3 findings.

addition, commanders should encourage their soldiers to strive towards optimal dental health, thus better preparing the soldier to be able to complete his wartime mission by not becoming a noncombat dental emergency. Anything short of ensuring that reserve soldiers are fully deployable could severely hamper the ability of the soldier to complete his mission in future conflicts.

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The Reinforced Tooth Pontic: An Esthetic Alternative

LTC Lawrence G. Breault†
MAJ Edward B. Fowler††
LTC William F. Bruce, Jr †††

This article describes an esthetic and functional technique which may be utilized in those clinical situations requiring the immediate replacement of a lost anterior tooth. It combines the use of the patient's natural crown as a pontic, bonded with composite resin, and reinforced by an intracoronal orthodontic wire. This technique is both simple and requires no dental laboratory support. It is specifically recommended for use in small isolated dental clinics, or in those rare dental emergency situations where the patient requires an immediate fixed prosthesis.

Introduction

Missing teeth are most often replaced for reasons related to cosmetics, masticatory function, phonetics, and space maintenance.[1] With the loss of an anterior tooth, either through surgery or trauma, the dentist is forced to consider an immediate means to satisfy the patients' cosmetic requirements. In the conventional dental practice, numerous methods and materials are available to assist the clinician in meeting this challenge. Treatment options range from the popular transitional acrylic resin removable partial denture (RPD), to the provisional resin fixed partial denture (FPD) involving immediate preparation of the abutment teeth.[2-4] These treatment options have associated factors including prior treatment planning, dental laboratory support, and/or extensive scheduled chairside treatment time. In situations found in small, isolated dental clinics or when faced with an avulsed tooth that can't be reimplanted, particularly if it occurs as an after duty hours dental emergency, prosthetic treatment options for an immediate restoration can be severely limited. Additionally, laboratory support and available treatment time factor into the care one can provide the patient.

Two early techniques, by Barkmeier et al and Portera, demonstrated the advantages of using the natural tooth as a pontic.[5,6] Hannon et al, reported that composite resin bonded prepared natural teeth can result in a fixed provisional restoration that can be the most realistic and cosmetic.[1] Composite resin by itself, however, has demonstrated a lack of strength when used alone in situations of tooth mobility, such as periodontal splinting.[7]

The two case reports describe the use of a patients' natural crown(s) to replace anterior teeth without dental laboratory support. This technique is a modification of previously described procedures using natural tooth crowns.[8-10] To increase resistance to displacement of the pontic, the technique was modified by incorporating an orthodontic wire. The wire is bonded into a lingual preparation within the pontic and conservative preparations on the adjacent teeth.

Case 1.

A 38-year-old soldier had been an active patient at a U.S. Army periodontic clinic for the past 3 months. He reported to the clinic for a scheduled appointment and stated that his maxil-

lary left central incisor had been traumatically avulsed 3 weeks earlier (Figure 1). The patient had not sought emergency care for this injury. Treatment options were discussed with the patient. He rejected any plan involving a removable appliance, such as an immediate resin RPD. He was not a suitable candidate for a conventional FPD, due to the questionable prognosis of the remaining anterior teeth. Additionally, the dental clinic was isolated and lacked the laboratory support to meet the patient's demands for a fixed appliance or a dental implant. A reinforced tooth pontic/composite resin FPD was presented as a compromised treatment option that would meet the patient's immediate needs.

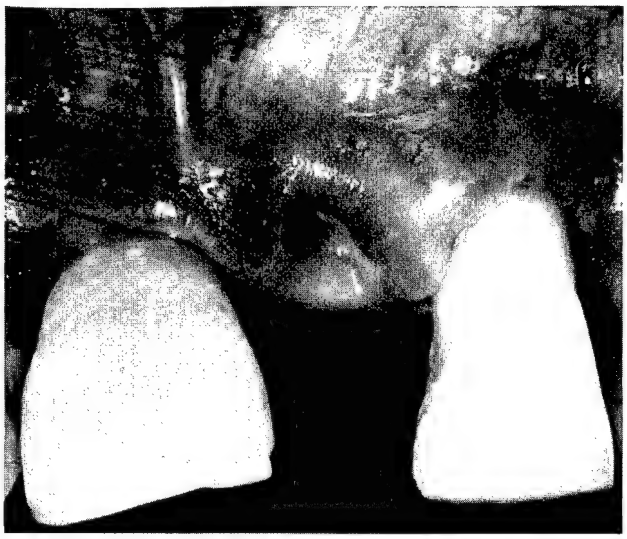

Fig 1. Patient with avulsed maxillary lateral incisor (tooth No. 9).

After the traumatic avulsion, the patient stored the tooth for the subsequent 3 weeks in a sealed plastic bag in a moist towel. In order for the crown to fit into the pontic space, the root was sectioned from the crown. After sectioning, gutta-percha obturating material from previous endodontic therapy was removed and the pulp chamber sealed with composite resin.

After checking the abutment teeth for occlusal interferences, rubber dam isolation was achieved, thus enhancing ideal bonding conditions. The natural tooth pontic was adjusted to fit into the mesiodistal edentulous space. Then, a 1mm x 2 mm groove was prepared at the mesiopalatal and distopalatal aspect of the pontic. The natural tooth pontic was subsequently etched for 30 seconds with phosphoric acid, rinsed with water, and dried with oil-free air. A layer of bonding agent was painted onto the preparations, followed by light-cured composite. A 0.032 inch round orthodontic wire was embedded into the composite and cured. The pontic and its embedded wires were repositioned into the edentulous space and the adjacent teeth were prepared with conservative proximal grooves (Figure 2). The pontic was secured in proper

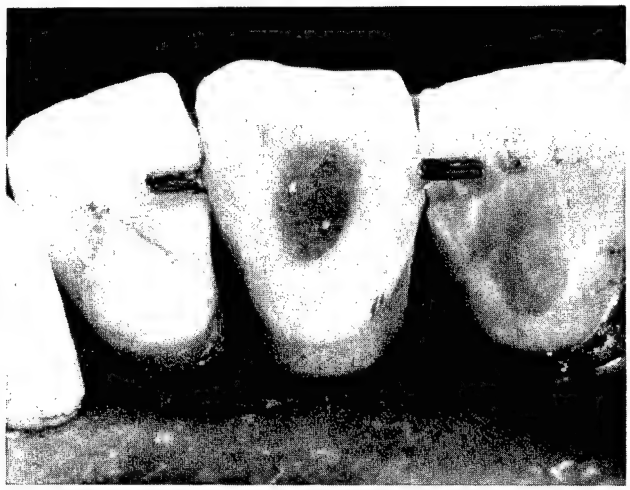

Fig 2. Tooth pontic with bonded orthodontic wire positioned between abutment teeth.

position by etching the abutment preparations, bonding, and embedding the wire within the composite. Further retention was provided by the placement of additional composite resin on the mesial and distal interproximal surfaces of the pontic and abutment teeth. Final composite adjustment and polishing was completed (Figure 3). Composite resin splinting of the remaining anterior teeth was utilized to provide additional stability to the anterior dentition.

Fig 3. Bonded natural tooth pontic with excellent esthetic results.

Case 2.

A 22-year-old soldier presented to the periodontic clinic with a diagnosis of Localized Juvenile Periodontitis (Figure 4). The patient presented with 90% to 95% bone loss of the mandibular central incisors with Miller Class 3 mobility.[11] To maintain the mandibular anterior dentition while undergoing periodontal therapy, composite resin FPD reinforced with orthodontic wire was proposed as a long-term, interim restoration.

Fig 4. Patient diagnosed with Localized Juvenile Periodontitis and minimal bony support of the mandibular central incisors.

Prior to the extractions of both mandibular central incisors, a pre-extraction matrix was fabricated. This matrix would later be used to guide the alignment of the pontics (Figure 5). Such a matrix can be made from many different types of materials—plaster, acrylic resin (Duralay®, Reliance Manufacturing Co, Worth, IL), or in our case, hydrophilic vinyl polysiloxane impression material (Blu-Mousse®, Parkell Biomaterials Division, Farmingdale, NY).

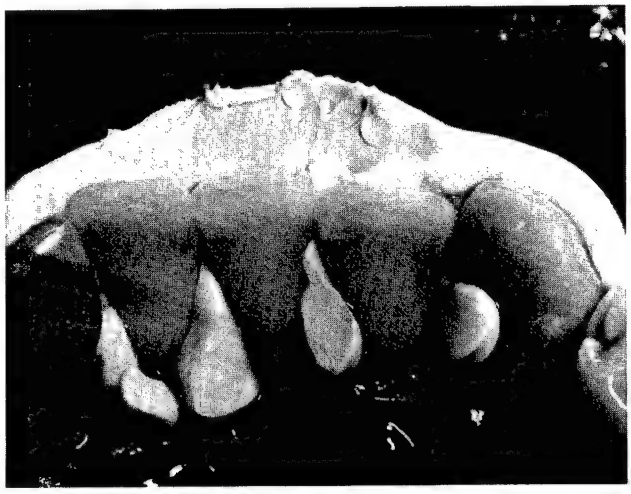

Fig 5. Poly vinylsoloxane matrix registration of the mandibular central incisors prior to extractions.

Prior to extracting the hopeless incisors, the apico-occlusal height needed for an esthetic pontic was estimated. The root can be scored with either a small round bur or marked with a pencil at the anticipated height of the healed extraction sites. To minimize subsequent discoloration of the pontics, residual pulpal tissue is removed from the pontic crowns after the teeth are extracted. The pontics are then sealed with composite resin as previously described.

The pre-extraction matrix material is then utilized to maintain the pontics in proper alignment while the orthodontic wire is bonded into the lingual pontic preparations (Figure 6). Following rubber dam isolation, proximal preparations in the abutment teeth are prepared. The matrix is then used to align the pontics within the edentulous space (Figure 7), and the pontics subsequently bonded to the abutments. The case is completed after the occlusion is adjusted and the resin polished (Figures 8 through 10).

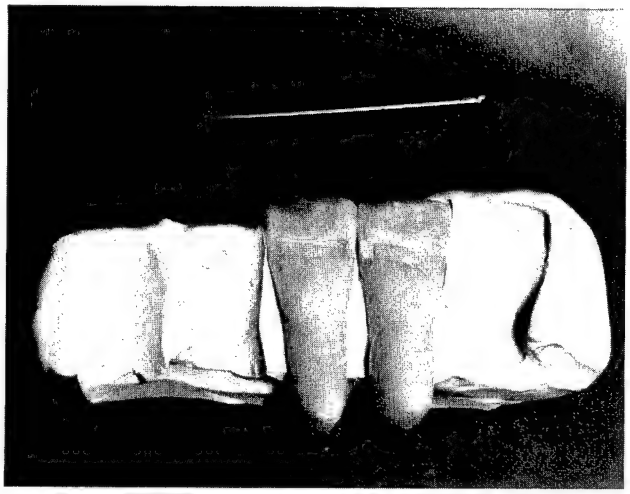

Fig 6. Matrix registration holding the mandibular pontics in alignment for incorporation of the pontic orthodontic wire.

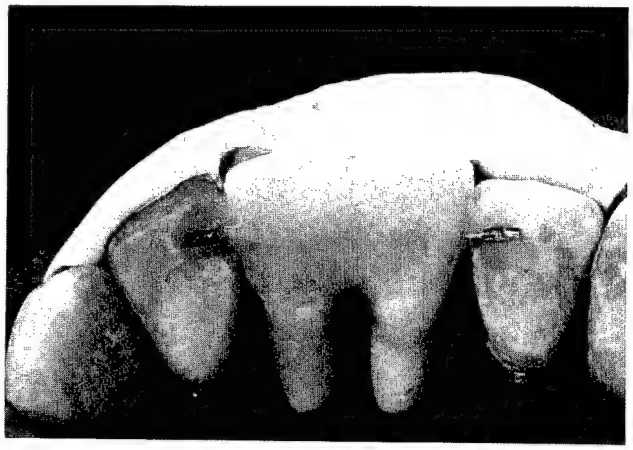

Fig 7. Matrix registration aligning the pontics within the edentulous space prior to bonding pontics to the abutment teeth.

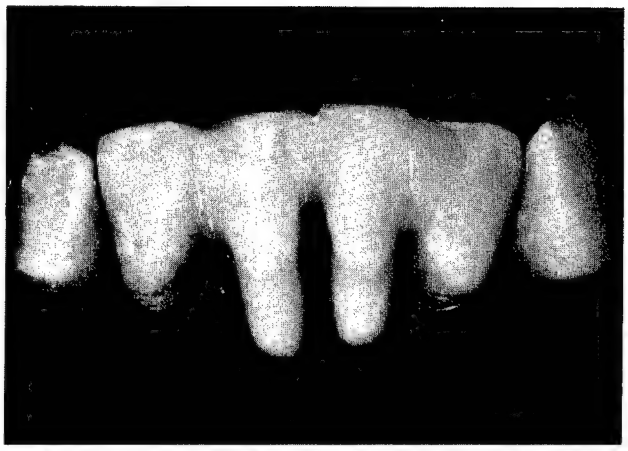

Fig 8. Facial view of the completed pontics prior to rubber dam removal.

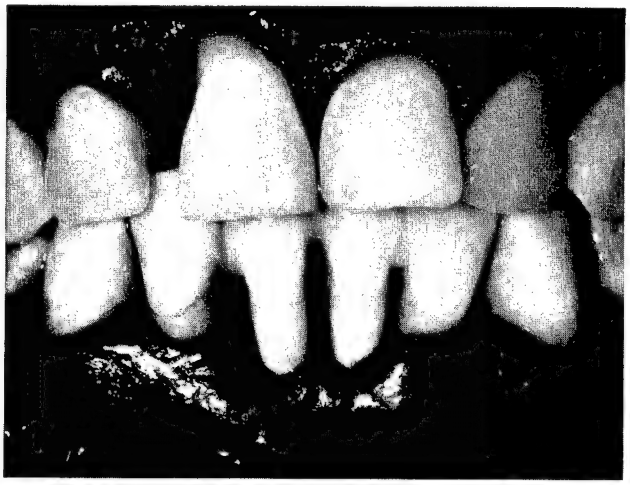

Fig 9. Completed pontics after occlusal adjustment.

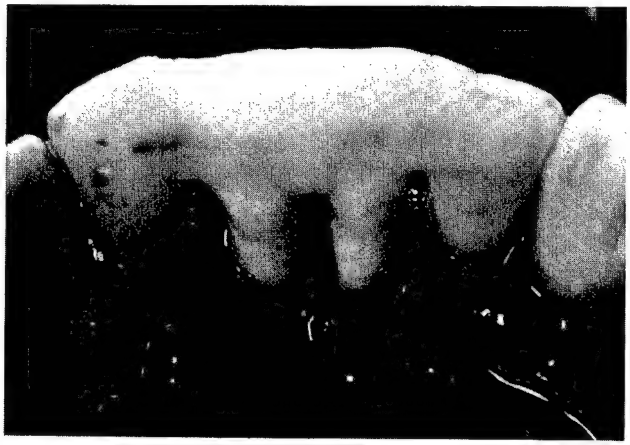

Fig 10. Lingual view of completed pontics.

Summary

These case reports demonstrate the use of a natural tooth as a pontic which is reinforced with orthodontic wire and bonded with composite resin. This treatment option can be accomplished without the use of a dental laboratory. Furthermore, this fixed restoration can be provided efficiently, minimizing chair time for the dentist and the patient. The result is esthetic and can be utilized as either a short- or long-term compromise to standard dental therapy. Additionally, a reinforced tooth pontic can be used in situations where complicating factors, such as mobility or poor, long-term prognosis preclude implants or conventional FPD. Through the combined use of natural teeth, orthodontic wire, and composite resin (all readily available items in dental clinics), the patients' desires for an esthetic and fixed restoration can be satisfied.

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Book Reviews

The following volumes were reviewed by MG (Ret) Floyd W. Baker, former Commander, U.S. Army Health Services Command (Jul 83-Jul 86).

Role Perceptions of Army Healthcare Administrators: Strategic Implications for Leader Development *by Army War College Strategic Studies Institute, Carlisle Barracks, LTC David A. Rubenstein, U.S. Army.*

The basis for this report was a biannual survey of Army healthcare administrators over a 9-year period, 1988 to 1996. The survey instrument was designed to assess the perceptions of various aspects of the roles these administrators fulfill. It is significant that there was consistently an excellent response rate, the lowest being 90% with 1 year being 100%. Since the survey was sent to every Medical Service Corps hospital administrator (Deputy Commander for Administration or Chief of Staff), the results should be quite reliable in reflecting the perceptions of the population.

The survey questions were developed after review of relevant literature and interviews with senior Army Medical Department officers involved in healthcare administration. The questions used were those employed by Dwore and Murray in a civilian setting. It was felt that using an accepted instrument would minimize questions or errors raised by validity and reliability issues and also provide an opportunity to make comparisons of two distinct groups of hospital administrators.

The survey results show the deep impact of 9 years of turmoil on the healthcare administrator. The shifting attitudes of, the importance of, the time spent in, and the satisfaction gained from the roles of entrepreneur, resource allocator, and disturbance handler are particularly striking.

The author has suggestions for The Surgeon General of the Army to use in developing education and training policies and for educators in the U.S. Army-Baylor University Graduate program in Healthcare Administration. These suggestions are valid; however, the rapidity with which changes are occurring in the Army Medical Department means that the perceptions today, in 1998, are no doubt somewhat different than those reflected in the 1996 survey. The plan to continue this study biannually is important, but education and training plans should be developed, not on the snapshot resulting from each survey, but on projections into the future that the trends seen in the series of surveys display, amplified by every crystal ball capability available.

Community Health Promotion Ideas that Work: a Field-Book for Practitioners *by Marshall W. Kreuter, Nicole A. Lezin, Matthew W. Kreute, Lawrence W. Green, Jones and Bartlett Publishers.*

Although this book is already relatively small, it could have been shortened considerably had the authors used the normal textbook format. They, however, chose to employ case studies which add a good deal of interest and have the potential for catching and holdings one's attention and for aiding memory. The cases are fictional and the text is livened by the inclusion of photos of the characters. With tongue in cheek, I might comment that they chose the wrong model for an Air Force captain—he sports a full beard! It is heartening, though, to feel that the authors recognize that we in the military do have an interest in community-health, wellness, and fitness.

A good mix of theory and tactics is found in the book, which is organized in seven chapters. The introduction is very well written in that it presents a brief description of each of the chapters, giving the reader a preview of what is to come in the book. Each chapter also concludes with a good summary.

The first chapter asks the question, "Why do we do what we do?" The case study used and the discussion of it make very clear the importance of developing a solid data-driven foundation and of obtaining an organizational commitment to any community health program. The subsequent chapters deal with various aspects of theory and tactics.

The authors emphasize that the format is not that of a cookbook; however, there is a wealth of material in the form of charts and tables that can provide help in putting together a recipe for a particular program. The book is only 203 pages in length, is easy to read, and contains much that could help practitioners answer the question in the paragraph above, and to apply that insight while employing *Ideas That Work* in their communities.

Strategic Management of Healthcare Organizations *by Peter M. Ginter, Linda M. Swayne, W. Jack Duncan, 3d Edition, 1998, Blackwell Publishers*

If one is looking for a short course or quick fix in strategic management, this is not the book to be reading – it is 857 pages long. It is, however, a very exhaustive textbook on the subject which is written in a manner that does allow one to get a good overview of strategic management of healthcare organizations by reading the introductions to and the summaries of the 14 chapters.

The first chapter gives an overview of the nature of strategic management in healthcare organizations and also of a specific model of healthcare strategic management. The following chapters examine the strategic processes included within the model. Following the chapters are five appendices designed to aid in the analysis, discussion, and presentation of healthcare case studies.

The authors appropriately stress that the Chief Executive Officer (CEO) is a strategic manager with the preeminent responsibility for positioning the organization for the future and that the CEO must fully understand and support strategic management, or else it will not happen. In light of this, it would be well for those Army Medical Department executives who have not had the benefit of extensive management education that included strategic management to use this book to help them lead in this critical area. There is probably no decision-making environment today that is more difficult or complex than healthcare, and the turbulence and changes currently occurring in the military system put it right at the apex of complexity.

Page 442 lists "The Do's and Don't's of Strategic Management." It is a shame that the list is buried here instead of being on the first page, the last page, and at the beginning and ending of every chapter. It is a string of pearls!

This book is written with civilian, and to a lesser extent, nonmilitary government health systems in mind; however, much of what is presented is applicable to the military. In addition, the increasing interaction, including cooperative and contracting arrangements between military and civilian healthcare organizations, makes it imperative that the latter be understood by the military medical leaders.

AMEDD Dateline

Dr Wayne R. Austerman†

6 Oct — Edward T. Lyon, a nurse anesthetist, became the first man to be commissioned in the U.S. Army Nurse Corps. Lieutenant Lyon joined 3,500 commissioned women in the corps via an amendment to the Army-Navy Nurses Act of 1947. **(1955)**

12 Oct — First U.S. Navy vessel, the USS Jupiter, transited the newly-completed Panama Canal. The canal's construction was made possible by Colonel William Gorgas' eradication of yellow fever and malaria in the Canal Zone. Gorgas' father, Josiah, was born in Running Pumps, Pennsylvania, but served as the senior ordnance officer of the Confederate Army during the Civil War. His father's expertise at manufacturing weapons and ammunition had killed or wounded tens of thousands of U.S. troops, while the son's medical skill saved untold thousands of military and civilian lives while helping to unite two hemispheres. **(1914)**

18 Oct — Disease and heat exhaustion crippled an entire American infantry regiment within 4 days during combat operations against the Japanese on the Kapa KapaTrail in New Guinea. **(1942)**

21 Oct — Lieutenant Frances Y. Slanger, NC, died of wounds sustained when German artillery shelled her field hospital unit in Belgium. She was one of 16 Army nurses killed by hostile fire during World War II. **(1944)**

23 Oct — Brigadier General Lillian Dunlap, Chief of the Army Nurse Corps, became the first woman to serve as president of a Department of the Army promotion board. **(1973)**

1 Nov — Private First Class Desmond T. Doss became the first conscientious objector to receive the Medal of Honor. Medic Doss served with the 307th U.S. Infantry Regiment, 77th infantry Division, during the bloody battle for Okinawa. Doss was personally responsible for saving the lives of at least 75 American casualties while under heavy enemy automatic weapons fire. **(1945)**

2 Nov — Corporal James B. Gresham and Privates Thomas E. Enright and Merle D. Hay became the first American soldiers to be killed in action during World War I as they fell near Barthelemont, France, while serving with Company E, 16th U.S. Infantry Regiment, 1st Infantry Division. **(1917)**

4 Nov — To safeguard the health of the troops, the Continental Congress established statutory rations for the Continental Army. Issued uncooked, the rations included one pound of beef, pork, or salted fish per man per day, along with one pound of bread and one quart of

beer or cider. Six pounds of hard soap were issued each week to every 100 men for laundry and bathing purposes. **(1775)**

Major General Arthur St Clair presided over one of the greatest disasters in American military history when he led 1,400 regular troops and volunteers into an ambush laid by 1,000 Miami Indian warriors near the headwaters of the Wabash River, 100 miles north of Cincinnati, Ohio. Afflicted with rheumatism, asthma, and "colic," St Clair's lack of vigilance led to the loss of 637 killed and 263 wounded in the debacle. Senior Surgeon Richard Allison distinguished himself by helping halt and rally the fleeing troops, while Surgeon's Mate Victor Grasson was killed in action while aiding the wounded. **(1791)**

Doctor Richard Gatling of Indianapolis, Indiana, patented his design of the Gatling Gun, a six-barreled weapon capable of firing 200 rounds per minute. Gatling sincerely believed that his invention would end war by making it unthinkable due to the horrific carnage created by such weapons. **(1862)**

11 Nov World War I ended with a total of 53,400 American battle deaths, 63,100 nonbattle deaths, and 204,002 wounded in action out of 4,730,000 service members, of whom 1,390,000 saw active service in a combat zone. **(1918)**

14 Nov Captain Robert J. Carrara served as battalion surgeon in the field with the 450 men of 1st Battalion, 7th U.S. Cavalry, 1st Cavalry Division, as the unit was nearly over-run and destroyed during fierce fighting with enemy troops in the Ia Drang Valley, Republic of Viet Nam. This clash represented the first major engagement of the Viet Nam War between U.S. Army troops and North Vietnamese regulars. Medic Charles Lose used toilet tissue and T-shirts to bandage wounds and keep 13 comrades alive during the 2-day action after his medical supplies were exhausted. In 53 hours of battle, the Americans suffered 79 KIA and 121 WIA. Enemy losses totaled an estimated 1,850 killed and wounded and six prisoners of war. **(1965)**

21 Nov President John F. Kennedy's last official action prior to his assassination dealt with American military medicine as he dedicated a new building at the U.S. Air Force School of Aerospace Medicine, Brooks AFB, TX. **(1963)**

30 Nov Major General Patrick Cleburne, CSA, was killed in action at the Battle of Franklin, TN. The son of a physician, this Irish immigrant, a pharmacist by profession, settled in Helena, AK, prior to the Civil War. A strict disciplinarian, but beloved by his troops in the Confederate Army of Tennessee, Cleburne was also a bit eccentric. Visitors reporting to his headquarters often found their salutes being returned by Cleburne's pet raccoon, which perched on his shoulder as he worked at his field desk. Several physicians became combat troop leaders on both sides during the Civil War, but Cleburne was the only pharmacist to win such rank as a line officer. **(1864)**

8 Dec Adjutant General's Office Order No. 72 halted the issue of the daily whiskey ration to

the troops. The 0.47 liter liquor ration was ended because it was deemed to exert "pernicious effect upon their health, morals, and discipline." **(1830)**

10 Dec Treaty of Paris ended the Spanish-American War, which had begun on the preceding 21 Apr. United States Army losses totaled 369 combat deaths, 2,061 deaths from disease, and 1,594 wounded. **(1898)**

11 Dec Jonathan Letterman was born in Canonsburg, PA. The son of an eminent physician, Letterman graduated from Jefferson Medical College in Philadelphia in 1849. Entering the U.S. Army Medical Department's service, he spent 10 years in Florida, Kansas, New Mexico, and California. His reform of the Union Army of the Potomac's medical establishment, in 1862, gave the service its first modern field medical support system. **(1824)**

12 Dec The Union Army of the Potomac launched a day-long series of frontal assaults against the entrenched Confederate Army of Northern Virginia at Fredericksburg, VA, suffering 12,000 casualties and accomplishing nothing of value. The Union field medical support system functional superbly, clearing the battlefield of all wounded within 2 days. **(1862)**

17 Dec Several medics were among the approximately 90 American soldiers massacred by German SS troops near Malmedy, Belgium, during the "Battle of the Bulge" in World War II. **(1944)**

18 Dec Continental Army went into winter quarters at Valley Forge, PA. By spring, disease, malnutrition, and exposure had generated 2,000 deaths among the 12,000 troops. **(1777)**

19 Dec General Dwight D. Eisenhower contributed to the 5th U.S. Army's preventive medicine disease control efforts by fatally shooting a rat, which he found in his quarters' lavatory in the Villa de San Silvestro, Caserta, Italy. Four shots from a Colt .380 automatic pistol dispatched the aggressive rodent. **(1943)**

23 Dec General Hideki Tojo, Japanese Prime Minister of war during 1941 to 1945, went to the gallows after his conviction for multiple war crimes. Prior to his execution, the defeated warlord had undergone dental treatment by CPT E.J. Mallory, DC, who engraved the Morse Code symbols for "Remember Pearl Harbor" on one of the doomed militarist's fillings. **(1945)**

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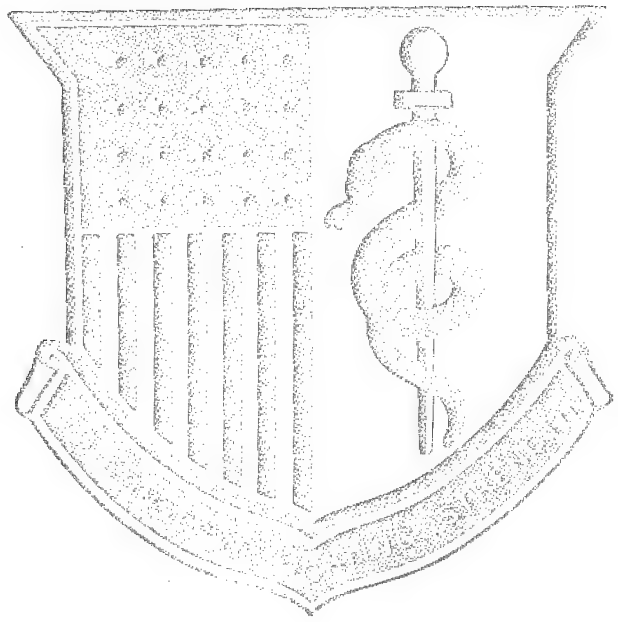
†Dr Austerman is the Historian, U.S. Army Medical Department Center and School, Fort Sam Houston, TX.



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Combat Medic Prayer

Oh Lord, I ask for the divine strength to meet the demands of my profession. Help me to be the finest medic, both technically and tactically. If I am called to the battlefield, give me the courage to conserve our fighting forces by providing medical care to all who are in need. If I am called to a mission of peace, give me the strength to lead by caring for those who need my assistance. Finally, Lord, help me to take care of my own spiritual, physical, and emotional needs. Teach me to trust in your presence and never-failing love.

Amen

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Manuscripts should be submitted with the following guidelines:

1. Manuscripts will be reviewed by the Journal staff and, if appropriate, forwarded to the AMEDDC&S activity having subject matter expertise for further assessment.

2. It may be necessary to revise the format of a manuscript in order to conform to established page composition guidelines.

3. Articles should be submitted in disk form (preferably Microsoft Word on 3.5" disk) accompanied by two copies of the manuscript. Journal format requires four double-spaced typewritten pages to complete one page of two-column text. Ideally, manuscripts should be no longer than 20 to 24 pages. Exceptions will be considered on a case-by-case basis.

4. The American Medical Association Manual of Style should be followed in preparation of text and references. Abbreviations should be limited as much as possible. A list identifying abbreviations and acronyms should be included.

5. Photographs submitted with manuscripts can be black and white or color. Color is recommended for best print reproduction quality. Space limitations allow no more than ten photographs per manuscript. Only photographic prints will be accepted for publication. Slides, negatives, or X-ray copies will not be published. Their position within the article should be clearly indicated in the manuscript. To avoid possible confusion, the top of photographs should be marked on the reverse. Photo captions should be taped to the back of photographs or submitted on a separate sheet.

6. A complete list of references used in the text must be provided with the manuscript. This list should include a maximum of 25 individual references. Each should provide the author's last name and initials, title of the article, name of the periodical, volume and page number, year of publication, and address of the publisher.

7. Drugs should be listed by their generic designations. Trade names, enclosed in brackets, can follow.

8. The author's name(s), title, current unit of assignment, PCS date (if applicable), and duty phone number should be included on the title page.

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